

S. H. i.

HUMAN OSTEOGENY

explained in

TWO LECTURES,

Read in the *Anatomical Theatre*
of the *Surgeons of London*.

JULY the *first* and *second*, anno 1731.

In which not only the beginning and gradual increase of the *bones* of *human foetuses* are described; but also the nature of *ossification* is considered, and the general notion, *That all bones are formed from cartilages*, is demonstrated to be a mistake.

By ROBERT NESBITT, M. D.

Fellow of the Royal College of PHYSICIANS,
and of the ROYAL SOCIETY, and Reader of
ANATOMY at Surgeons Hall.

The main Business of Natural Philosophy is to argue from Phænomena, without feigning Hypotheses, and to deduce Causes from Effects, till we come to the very first Cause, which certainly is not mechanical.

Sir ISAAC NEWTON's Opticks, Q. xxviii.

L O N D O N:

Printed by T. Wood, and sold by W. INNYS and R. MANBY,
J. PEMBERTON, E. SYMON, J. NOON, and C. DAVIS.

M DCC XXXVI.

12



402



T O

D^r. JAMES DOUGLAS,

Physician in extraordinary to the **QUEEN,**

Honorary Fellow of the Royal College of **PHYSICIANS,**
and Fellow of the **ROYAL SOCIETY.**



HE character,
dear Sir, which
you have now
for many years
acquired, of being as ca-
a 2 pable

pable a judge of the truth and justness of all anatomical performances, as any age has produced, will, I doubt not, cause my readers to think all excuses, both for printing these *Lectures*, and inscribing them to your self, entirely needless; when they are informed, it was by your persuasions alone, that I was prevail'd on to revise, and thus make them public, after they had for some years lain by me disregarded. Your want of leisure to publish the osteology of adults, which you had many years since nearly perfected,

DEDICATION.

v

fectcd, caused you to despair of ever finding time sufficient to add osteogeny to that work; for which reason you urged me to publish what I had written on that subject; tho you knew it was composed only for the use of the *anatomical theatre*. As I was, when I drew up these Lectures, entirely of your opinion, that little regard ought to be given to any thing advanced in anatomy, which is not demonstrable by proper preparations; I was obliged, in order to prove to my hearers the truth of my descriptions, to make a
large

large number of preparations very different from what I had ever seen in any anatomical *museum*, except that very curious one of professor *Albinus* at *Leyden*. When you examined those preparations, you was pleased to approve of them; because each part, I designed to describe, was preserved in its natural shape and colour. Hence you was induced to believe me sufficiently qualified to give the public better and truer representations of the various parts of skeletons prepared from *fætuses* of a different age, than had been
done

done by any writer on osteogeny ; since, as you justly observed, all their sculptures of such skeletons, hitherto published, having been taken from dried preparations, must consequently represent the parts very different from what they appear to be in a natural state. I assure you, nothing will encourage me so much to pursue anatomical researches, whensoever leisure and opportunity serve, as your approbation of what I now present you with ; which also will make me both expect the favourable sentiments of all other competent

petent judges, and think
my self sufficiently reward-
ed for the time and pains
already employed in such
enquiries by,

Dear Sir,

Your affectionate brother,

and most obliged

humble servant,

ROBERT NESBITT.

Basinghall-Street,
January 12, 1736.

TO THE
READER.

SINCE the first of these Lectures, which contains a short account of the manner and cause of bony productions, was printed off, I have had the pleasure of finding the notion, which the sagacious Dr. Pitcairn entertained, concerning the manner of ossification, to be in part agreeable to what I have there advanced. Tho it seems, by his mentioning Gagliardi's supposed claviculi, to be founded chiefly on his mistaken account of the texture of bones. His words are, *Superficies ossium concentricæ nihil aliud sunt, quam membranæ plures sibi mutuo superpositæ, quarum pori replentur corporibus duris e succo durante derivatis; ille succus per arterias advectus (refluentibus per venas partibus fluidioribus) exsudat*

b

in

To the READER.

in poros membranarum, quæ circumvolutæ os constituunt. *Pitc. Elem. Med.* l. i. c. 5. § 81. So much of this account as relates to a juice impregnated corporibus duris, or, as he afterwards expresses it, materia gypsea, being brought to ossifying parts in the arteries, and the more fluid part of that juice returning by the veins, is entirely agreeable to what I have demonstrated from various appearances of nature. But the exsudation of these hard bodies, or gritty matter, into the pores of the membranes, is altogether imaginary. Had this great man, qualified with such a physical genius, as he appears to have been, given himself the trouble of accurately examining these parts, we might reasonably have expected from him almost a perfect account of this part of the animal œconomy. But, alas! thus we frequently find the most capable persons least inclined to take the pains necessary to search out real phænomena sufficient to ground their reasonings upon, and therefore often attempting

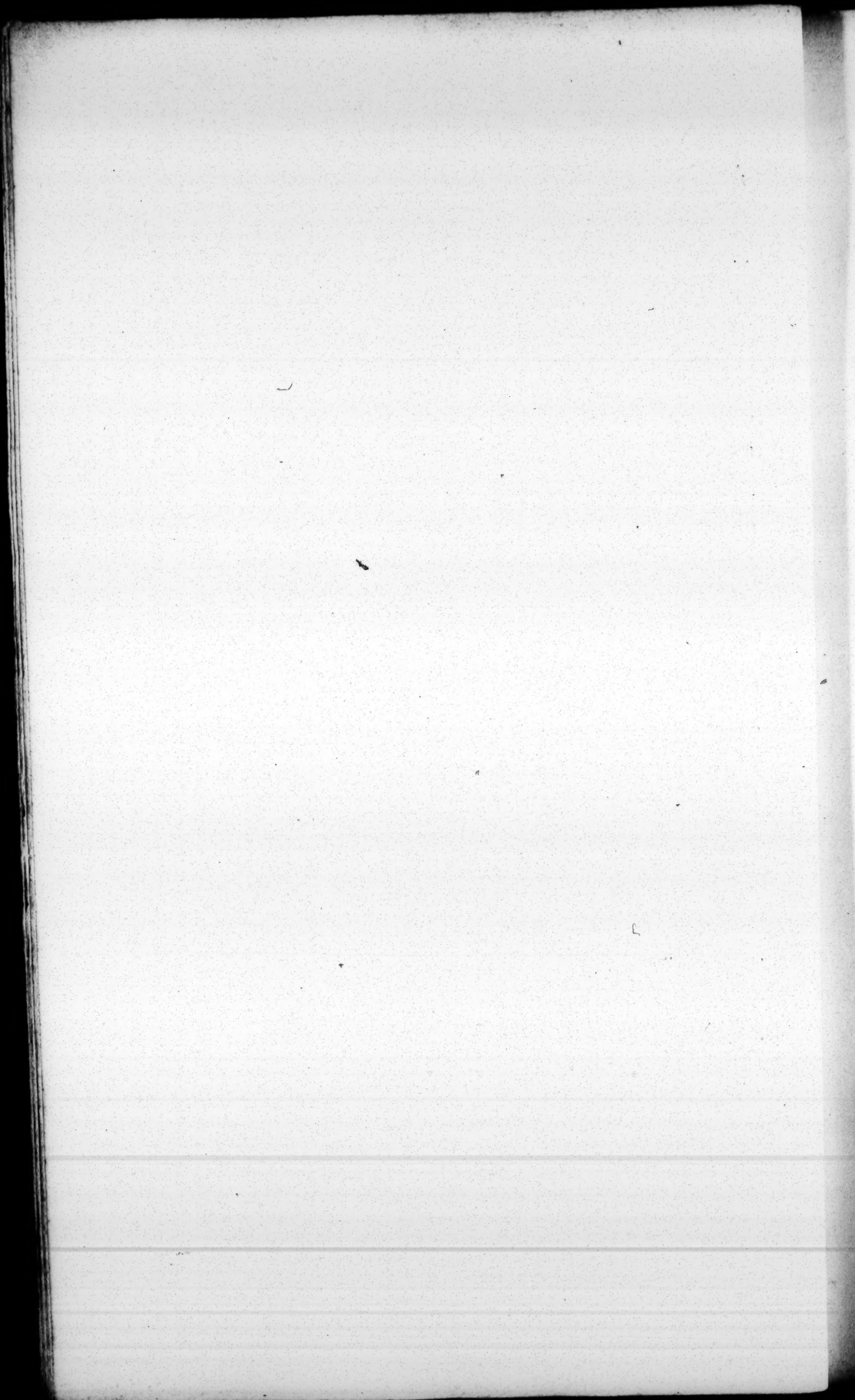
attempting to supply that defect by their lively imaginations.

I thought it not necessary, in order to illustrate the second Lecture, to follow the example of Kerckringius, in giving sculptures of every part of a foetus of each month from the second after conception to birth; because these parts do not every month differ in shape or substance, tho they do in magnitude, and therefore I have only exhibited figures from three or four foetuses of a different age. I once purposed to have given representations of the periosteum, cartilages, and bones injected, from exceeding curious preparations in the museum of Dr. Nichols, which is indisputably the most copious and best of that kind, that was ever made in this nation; but I was soon deterred from pursuing my design by the difficulty I found in getting those small vessels accurately and distinctly drawn. And, for a like reason, I was prevented from giving draughts of whole skeletons, finding it was scarcely possible to fix an undried

and well cleaned skeleton of a foetus in a natural posture, so as to take the outline true and beautiful. The sculptures, which I have procured to be made, I confess, come somewhat short of what I designed and expected. Tho I flatter myself, as to exactness, when compared with the best of any kind yet published, they will not appear inferior to the most correct; because the outlines of most of the figures, especially those of the full grown foetus, were taken in a camera obscura, and therefore cannot err greatly from the truth.

SINCE the descriptions of adult bones have been frequently published by able hands, I much wonder some person has not attempted to give an exact account of the time when, and the manner how each bone, and its various parts increase and alter from the time of birth to that of its maturity; because such an account is absolutely necessary to perfect the osteological part of anatomy. In my apprehension such a work would not only be entertaining, but also very useful both
in

in physick and surgery. For, by the few dissections only, which I have made on that account, it appears to me, that the want of it is the sole cause of some distempers of bones and cartilages being not only imperfectly, but falsely described; and none more than that peculiar to children, commonly known by the name of the rickets. The knowledge of this, I am satisfied, might be so far improved by the help of proper dissections, as to afford sufficient data, from which to deduce a rational method of cure. Therefore I purpose, if opportunity offer, of dissecting some more such morbid subjects, to give the public a brief account of the rickets, and suchlike distempers incident to bony parts, wholly taken from very manifest phenomena, which I conceive to be always visible within such diseased parts, altho they have not hitherto been observed, or at least described, so far as I know, by any author.





HUMAN OSTEOGENY.

LECTURE I.

NO part of physick or surgery hath received greater improvements in this or the last age, than Anatomy. Human dissections were by most of the ancients, especially those whose writings are handed down to us, so rarely used, that the knowledge they seem to have had, was chiefly comparative, and consequently turn'd to so little account, that most of the admirable and curious contrivances of the human machine were entirely unknown to them. But since dissections of all sorts have been frequent, both in public and private, and many lovers of and searchers after

A

na-

natural knowledge have applied themselves with great care and industry to anatomical inquiries; the improvements in the knowledge, not only of the structure, but also of the uses of most parts of the body have been so considerable, as to make what the ancients knew in this science appear both insignificant, and often trifling, when compared to that of the moderns. And yet on a further examination it may be easily perceived, that great room still remains for improvements in many parts of this science, and in none more, than in some parts of Osteology, especially in that I now design to treat of, which is commonly called *Osteogeny*.

It is surprising, that the writers* on this subject, and especially *Kerckringius*†, who pretends to much greater accuracy, than any who wrote before him, should be so negligent in their accounts of the rise, progress, and manner of ossification in different parts, from its first appearance to the time of birth, that many of its curious and very obvious *phæ-*

* Riolanus, Eyssenius, Coiterus.

† Kerckringii Osteog. foetuum.

nomena have been hitherto entirely past over by them unobserved, and not a few others described or represented very different, from what they naturally appear to be.

HENCE no doubt it is, that the truth has been so long concealed, and its place supplied by hypotheses, which had no foundations, but in the imaginations of their ingenious inventors; altho the different times and gradual manner made use of by nature to produce the bones of an human body, make her operations so much more conspicuous in those, than any other parts, that by the visible effects of ossification a careful and diligent enquirer may reasonably expect to come nearer to the knowledge of its first cause, than he can of any other part of an animal.

WHAT I intend in this lecture is to advance little or nothing but what may be demonstrated by preparations of different parts of human *fœtuses*, and to use no arguments to support my opinions but what may fairly be drawn from nature itself; it being far from my intent to endeavour to shew, as others have of-

ten done, the falsity of a general received hypothesis, in order only to establish one of my own, which might be as liable to objections, and have as little foundation in nature, as that I propose to confute. Therefore after I have given a short description of the *periosteum*, and an account of what sort of a substance a cartilage is, I shall relate, what is visible of the manner of ossification, and from that shew the ancient and common notion of all bones being originally cartilaginous, to be a vulgar error; and then enquire whether the related effects of ossification do not almost help us to the knowledge of the immediate productive cause of bony substances; and afterwards examine the objections, that have or probably may be raised to my account. In my next lecture I shall give an exact description of the apparent difference, there is naturally to be perceived between the parts of a fresh or undried skeleton of a full grown human *fœtus*, and the skeleton of an adult, and also briefly mention, in what manner, and at what time, each bone and its several parts increase and vary from its
first

first appearance to the time of birth. In doing of which I shall not describe or take any more notice of the figure and shape of these bones, than what is necessary to exhibit, *in what they differ* from full grown ones. Therefore I shall suppose my hearers thoroughly acquainted with the adult osteology, for which reason also I shall omit describing the ligaments, and giving an account of the articulations or any thing else, that is usually observed of these parts, which is not necessarily or best explained by preparations from *fœtuses*.

THE PERIOSTEUM is a delicate fine and strong membrane, *plate vi. fig. 4. a.* Of the periosteum. which is spread on and covers not only all the bones in general, but is also continued over all cartilages, that have any connexion with them; where, from its situation, it acquires the name of *perichondrium*. Part of it also may be always traced over the ligaments of the articulations.

THIS membrane is formed by many different courses of fibres not all interwoven one within another, but placed in several series over each other.

ITS

ITS inner *strata* or layers are distinct and uniform, and generally run according to the length or fibres of the bone it covers, pretty near parallel to one another.

ITS outer *strata* commonly have their fibres directed according to the courses of the muscular fibres, which are immediately attached to them, and from which they chiefly arise.

EVERY part of this membrane abounds with arteries and veins, and the great sensibility, with which it is endowed, is a sufficient proof of its being well provided with nerves, tho they are too small to be traced.

IT is strongly joined to the bone both by its inner fibres, which penetrate in many places the bone's substance, and by its blood-vessels, which enter the bone almost in every point of its surface.

THE membrane, which covers or lines the internal or cavernous parts of a bone, is generally called the *internal periosteum* ; but whether it is any thing more, than what forms the *folliculi* which contain the marrow, I much doubt, tho I shall continue to call it by its usual name,

DR.

LECTURE I.

7

DR. *Havers* * and others have taken much pains in attempting to prove the *periosteum* of every bone to take its rise from the membrane, which lines all the internal part of the *cranium*, and is commonly called *dura mater*. But as it is certain the *dura mater* is a *periosteum* of those bones it lines, and does not exist before the *periosteum* of many other parts, there can be no reason for supposing the one to be beholden to the other for its origin, altho I question not, but the *periosteum* is one continued membrane over all the bony and cartilaginous parts of a skeleton, as *Havers* has rightly observed.

A CARTILAGE is a white elastic substance, to appearance uniformly solid, and harder than any other part of an animal, except bone, to which it is in no other respect peculiarly similar, than in its covering, which, as has been mentioned, is call'd the *perichondrium*, and, like the *periosteum*, is spread over every part of its surface, *plate vi. fig. 4. b.* to

Of Cartilages.

* *Havers's Osteol.* Nov. Disc. I.

which

which it is almost in every part joined by blood-vessels, that appear, when this membrane is separated, after a proper injection, by the small red specks on the cartilage.

SOME great Anatomists have imagined the *perichondrium* not to be spread over those parts of cartilages, which by the motion of the joints are continually subject to great frictions. The great difficulty, if not impossibility, to separate this membrane in adult subjects, was, I don't doubt, the occasion of their mistake; but had they attempted to do it in young *fœtuses* they would seldom have failed of success. *Plate vi. fig. 4. b. c.*

THE long macerations of the great Anatomist Dr. *Nichols* seem to prove, that cartilaginous substances are fibrous, altho the finest microscopes do not discover the dispositions or courses of the fibres.

THAT the *perichondrium* as well as the *periosteum* is supplied with nerves for sensation, most writers deny, because that part of it, which is liable to friction on every motion of the joint, seems to be
alto-

LECTURE I.

9

altogether insensible. But as I have seen an instance of a degree of sensibility in it, and as it is indisputably a continuation of a most sensible membrane, I cannot agree with them, that it is entirely void of all manner of sensation.

AT the extremities and in the articulations of all bones, which are connected together for motion, cartilages are never wanting, because, by the uniformity of their substance, they are not so liable to receive injury from the attrition, which is made by the motion of the joints, as the hard and unequal substances of bones wou'd be: And their natural elasticity is of no small service in recovering their original shape when, by any extraordinary pressure, they have been forced out of it.

THE quantity of this substance is much greater at the first part of life, than the latter, because nature always makes use of cartilages to supply and fill up the places of those bones or parts, which require not so hard a substance as bone to perform its natural functions, until a considerable time in some parts after conception, and in others after birth ;

B

which

which cartilages afterwards serve as beds for the ossifications to shoot securely in.

The substance of the bones.

I NOW come to examine the substance of foetal bones, which are the hardest, most solid, and only brittle parts of the body.

BESIDES the fluids and marrow contain'd within them, their composition consists of membranes and cretaceous particles, which are what authors commonly call *bony*, and are peculiar to the bony parts alone in healthy animals, and will appear to be what really form these substances, the membranes being only either what surrounds and keeps the bony particles and fibres together, or vesicular coats.

The two species of Ossification.

THE bony particles in *fœtuses* begin to be deposited or to shoot either between membranes or within cartilages.

THOSE which shoot between membranes are what form most of the hardest and most solid of foetal bones, and appear much sooner than the others, which compose all *epiphyses*, and such bones only, whose places are supplied for some time by cartilages, which have
near-

nearly the same shape those parts are naturally of, when they become bony.

THE texture of that species of Ossification, which is produced between membranes, by a careful and proper examination, may be seen to be of small particles, so conjoin'd together, as to form fine bony threads or fibres, which are disposed differently, according to the particular formation of each bone, and its several parts. This is most visible in thin and broad bones, especially in some of those, which form the *cranium*, as you see in the syncipital bone of a *fœtus* about ten or twelve weeks after conception, in which the beginning of an ossification appears now, not as has been generally described to be only in the centre, and from thence to shoot as *radii* to a circumference; but, as the accurate and great searcher into the secrets of nature, *Malpighi** observes, *it has the appearance of an exceeding fine irregular piece of net-work*, the middle of which is much closer and finer than the circumference, and is so thin, that without the

The first
species of
Ossification.

* *Malpighii Opera Posth.*

greatest care it cannot be taken from between the membrane, which covers it.

IN preparations of subjects a little older, *plate i. fig. 6.* you may observe the bony particles to be gradually multiplied, and so conjoined in contact, as to produce the appearance of small fine bony threads or fibres, which then appear a little like *radii* shooting from a centre.

ALL the small furrows or vacancies between these fibres, which cause them to appear distinct, and thus to resemble *radii*, have by injections been demonstrated to be only passages for blood-vessels. And as the *fœtus* grows bigger, you may perceive, that the bony fibres do by degrees increase in number, and are continually forced, and probably attracted nearer to one another, until they are pressed so close together, as to permit no new matter to be deposited between them. Thus a single *lamina* or plate of this sort of bone is produced.

As the bone continues to grow and increase in size every way, many *strata* of similar plates are, by the bony fibres shooting on one another, in the manner just described,

scribed, gradually generated, by which the more solid part of a bone is formed.

IT is observable, that the inner *laminæ* are less solid, and more porous, than the exterior; and none of them acquire the solidity, they usually are found to have in adults, until the part has entirely done growing in bulk.

AFTER much the same manner those *laminæ* are formed, of which the more solid part of the cylindrical bones consist. Their ossifications begin, while the circumference of the part is not larger than a small pin, in the form of a broad flat ring, which surrounds the internal *periosteum*, and is surrounded by the external, *plate vi. fig. 7. a.*

As these rings increase in breadth, their fibres shoot toward both extremities of the part, not always in straight lines, but according to the particular figure the bone is designed by nature to be of.

IN these bones the interior *laminæ* are never so long as the exterior, because on the number of plates depends the extraordinary solidity of the bone about its middle, which gradually decreases toward its extremities, *plate vi. fig. 8. aa.*

IN

14 HUMAN OSTEOGENY.

IN like manner the more solid part of the palate, maxillary, and all other irregular shaped bones, which are generated between membranes, are composed of bony fibres, that shoot differently, according to their various figures and forms.

WHAT seems in perfect bony *laminæ* to be pores, are passages for blood-vessels: And the cellular or cavernous parts of bones are receptacles for the *folliculi* of marrow, *plate vi. fig. 8. bb*, to the intervention of which the cells or cavities owe their formation. For as the marrow increases, the bony particles are by pressure forced into a form proper and capable to contain the medullary bags, much in the same manner as the pressure of blood-vessels makes furrows or cavities to bury part of themselves in on the external *laminæ* of the parietal bones, as soon as they become fix'd by their futures.

I DOUBT not, but there are some, who will pretend to find cartilaginous substances over the frontal and parietal bones, and about others, which are here autoptically demonstrated to have none.

BUT

BUT in those bones of the *cranium* you may always discover with proper care, what they take for cartilage, to be nothing but membrane; as by the skull, which has the *pericranium* on one side of it remaining, it is manifest, by the resemblance you see that membrane has to a cartilage, it was what *Kerckringius** took to be cartilaginous in the middle or centre, as he calls it, of the *os frontis*. But had he been curious enough to have removed or separated it from the bone, he must have found his error, and been fully convinced, that there is not the least foundation in nature for what he so positively affirms.

IF the clavicle, which is a cylindrical bone, be accurately examined, when it is so small, as not to weigh the fourth part of a grain, *plate v. f. 7.* which is not more than the two thousandth part of the weight of a full grown one, it will be always found to be nearly of the same shape as adult ones usually have, and perfect bone, with its *periosteum* covering it; and has no more cartilage, or the least resemblance of one in or over

* Osteog. foet. cap. ii.

16 HUMAN OSTEOGENY.

any part of it, in proportion to its size, than such bones are found to have, when they have done growing.

IN like manner the same appearance of bone without cartilage, you may always find in those of the palate, upper jaw, and nose, when some of them are so small, as scarcely to be distinguished without the help of a glass, and as thin as an exceeding fine membrane.

THE teeth likewise are always found to be generated and accreted without ever having any cartilage or cartilaginous substance in or near them, from their first appearance to the time of their maturity.

The second species of Ossification.

THE other species of ossification, which first appears within a cartilage, begins late, and at very distant times in different parts. Its soonest appearance, which is either in the *ossa Ilii*, or some of the *vertebræ*, is not before the *fœtus* is more than two months old, and its latest is not until many years after birth. This species requires other preparations besides foetal ones to demonstrate perfectly the manner of its production; for tho in small spines, such as *plate iv. fig. 12.* a gradation

tion of ossification from a point to a considerable body, is always to be seen; by which many, seemingly with good reason, have been induced to conclude, that all such like ossifications begin in a point, and round that gradually accrete until the part arrives at maturity: yet an examination of those parts, which do not begin to ossify until a few weeks before birth, and have not their ossifications near finished until some years after, shew the bony particles to be very frequently deposited in various parts of the cartilage in distinct clusters irregularly situated; all which afterwards perfectly unite.

THOSE cartilages of almost full grown *fœtuses*, in which are to be found either tendencies to ossify, or ossifications just beginning, plainly shew that not one bony particle is to be perceived, or felt, before there is a visible influx into the cartilages of a fluid different from what used to flow through them: as in the sections of ossifying *epiphyses*, *plate vi. f. 9, 10.* you see both in that which has no visible bony particles, and others which have a few, many of those vessels, which while the part continued totally cartilaginous

ginous without a tendency to ossify, were too fine to be distinguished or perceived by the greatest magnifying microscopes, and consequently too small to admit the red globules of blood to flow freely thro them, appear to have been, by a more than usual afflux of fluid into them, so much dilated, as to receive a quantity of red globules, sufficient to make some part of them distinctly visible to the naked eye, and to cause in and near the place, where the ossification is to begin, and round it, always when just begun to be apparent, and frequently after it is considerably increased, *fig. 13.* the appearance of an inflammation.

THE first small corpuscles of bone, which become visible, are always in that part of the cartilage, which has the greatest quantity of red fluid appearing in it, and are not always placed close together, but often at small distances from each other.

IN some of the vessels, which are much dilated and appear full of blood, or a fluid very similar to it, there are often to be felt, with the point of a knife, hard gritty particles, which I take to be bony.

IN

IN some *epiphyses*, such as you see *plate vi. fig. 8. cccc. fig. 11. fig. 12.* there are often three or more very considerable vessels going to and penetrating the ossifications, within which vessels, and such like, at their ends, near the ossification, you will rarely miss feeling, by the point of a knife, bony particles. And if the cartilage be slit into thin pieces, and dried flat between two plane glasses, there are often to be distinguished by the naked eye, tho oftener by the help of a microscope, in these dilated vessels, what to me seem to have the true appearance of bony particles. In the little red specks, which sometimes appear with one or more small vessels ending in them, on sections of *fœtal epiphyses*, *plate vi. fig. 11. aa*, bony particles are generally to be felt, and sometimes even seen.

THUS much is evident, from *fœtal* preparations, of the manner in which these sort of bones begin, and continue until birth to be generated; but on examination of the same parts in children, three or four years after birth, the like *phænomena* will be much more apparent, because the vessels, which enter the ossifying

C 2

parts,

parts, are considerably larger, and consequently their contents more easily discovered. Moreover, you will seldom, if ever, fail of finding in the large *epiphyses*, particularly those at the bottom of the thigh bones of children between three and six years of age, considerable vessels, containing bony particles and a red fluid. And at the same time you may observe the progress of these ossifications to be after birth less uniform, and not so close together, as they are always found to be in *fœtuses*, but are irregularly deposited round, and joined to that part, which first began to ossify. In various parts also of the cartilage, which you find between the ossifications, there are frequently to be seen dilated vessels partly filled with bony matter.

MOST of this sort of bones are very spongy and cellular; and have the size and figure of their cells, which are generally small, regulated by the medullary and vesicular substances contained within them; and their external and more solid parts are composed of bony threads, which are disposed according to the shape of the part, in the same manner

ner as has been observed of the other species of ossification.

VERY soon after the *vertebræ*, and such like parts, which do not remain very long after conception wholly cartilaginous, begin to ossify, their increase is so manifestly more from the accretion of the bones, than the cartilages, that long before those bones arrive at half the size of adult ones, the cartilaginous substances decrease, and gradually, as the bones grow, become so thin, as to seem to be entirely destroyed, except next the joints, where cartilages remain for the benefit of the articulations, and continue in healthy subjects to grow, and receive nutrition, as long as any other part of the body.

How little *fœtal* bones are dependent on the cartilages, in which they are generated, may be made apparent, if any of them, while the cartilages entirely or almost surround the bone, be kept a sufficient time in water; for then, as you see, *plate iv. fig. 10. a. b. plate vi. fig. 17. a. b.* on only flitting the cartilage, the bone will, as soon as the large vessels that enter its substance are divided,

vided, slip as easily, if not easier, from it, than an acorn does out of its cup. And by the smoothness and polish of the parts of both cartilage and bone, which were in contact, it is very manifest, there could be no intermixture of their particles, or continuation of the fibres of one substance to those of the other.

THE cartilage also, which joins at birth part of the *os occipitis* to the hinder part of the *petrosus*, just beyond the place where the mammillary *apophysis* is afterwards form'd, demonstrates, that there is no conjunction or union of the fibres of these two substances, *plate i. fig. 12. k. fig. 13. k. plate ii. fig. 9. k.* For as soon as the *pericranium* and *dura mater* are removed, the cartilage, by gently pulling, will separate or come from the bone without the least laceration of its fibres.

THE material *phænomena* of the two species of ossifications having been already shewn and truly described; I come now to examine, whether by them it is not demonstrable, *that the notion of all or any bones being originally cartilaginous, is not without foundation in nature*, in order to inquire, how near the consideration

tion of these *phænomena* will bring us to the knowledge of the true manner and cause of bony productions.

IT is at present, if I am not very much mistaken, almost universally allowed, that all those juices, which are the productive causes of the accretions of each part of an animal body, are originally deduced from the mass of blood, and formed by different coalitions of various combined particles contained in it; which particles, by the power of circulation and attraction, are secreted, and forced into vessels capable, in a natural state, of receiving only such, and through them conveyed to the parts designed to be augmented. And it is as universally denied, that the juice, which is the primary cause of the productions and accretions of the bones, is capable of generating perfect bony substances, without first forming a cartilaginous one.

BUT by what has been related of the beginning and progress of bony productions in different parts of *fœtal* bodies, it appears to ocular demonstration, that some bones begin and continue to increase until they arrive at maturity, without

24 HUMAN OSTEOGENY.

out the least appearance of cartilage in or round them; and that others, though they are generated within cartilages, have not in or about them a quantity of cartilaginous substance existing, as long as they continue to grow, sufficient to afford matter for their increase in bulk or solidity; consequently, if any part of a bone be produced by a transmutation of a cartilage, nature must use various methods at different times to generate and accrete the same bone.

BUT as nothing is more certain, than that nature is never at unnecessary trouble in any of her performances, and is always so conformable to herself, as ever to operate uniformly in the most easy and simple manner, she cannot reasonably be supposed to produce similar substances in the same body, and at the same time, from different origins, and in different manners.

AND what you have seen of bones slipping out of the cartilaginous cavities, in which they were generated and contained, affords a plain autoptical demonstration of the entire independence of those two substances on one another, as
can

can be had, or reasonably expected of things of this nature.

AND besides, as a further consideration, if you examine, ever so accurately, ossifications in any aged subjects, you'll never find any particles or fibres in a middle state between bone and cartilage; which surely would at some time or other happen to be apparent, if the softer substance was gradually transmuted into the harder.

THAT the formation of all bony substances is immediately caused by secreted fluids, may be sufficiently proved by the *phænomena*, which have been shewn already to be always existent in cartilaginous parts, just before and after ossifications within them become visible. For by the remarkable dilatations of some vessels within the cartilages you saw, *plate vi. fig. 9, 10, 11, 12.* and the red colour of the fluid contained within those dilated vessels, it plainly appears, that nature never fails to supply all cartilaginous parts, both a little before and during the time ossifications are forming within them, with a quantity of a fluid very different from

The production of bones.

D

what

what at any other time is naturally to be seen in any part of them. And the appearance of bony particles only in that fluid, seems to prove that neither the solid nor fluid parts of cartilaginous substances are in the least concerned in bony productions.

THAT the Blood is capable at all times of life of generating and suspending a substance perfectly analogous to the cretaceous parts of bones, is demonstrable by the chemical analysis of those cretaceous substances, which are frequently found to be separated together with the urine from the blood; as likewise those substances commonly called *chalk-stones*, which are often generated in various parts of gouty bodies. These *chalk-stones*, tho they have been supposed to be caused by an induration of membranous and tendinous substances, will appear to be produced only by the coalitions of cretaceous particles contained and suspended in the blood, or a fluid separated from it, by only opening a tumified part, in which they are about to be generated, and letting out the fluid contained within it; which is a never failing

ing method used by some people to prevent the production or increase of those substances.

WHAT has been now observed concerning the different manners of bony productions, and the *phænomena* which are visible during the progress of ossifications within cartilaginous parts, are fully sufficient to prove all bony particles to be originally contained and suspended in the blood, or a fluid secreted from it, which may be called the *ossifying juice*, much in the same manner as stony and saline particles are very frequently found in some of the most transparent spring waters.

I MUST not here be understood to mean such bony particles as I described to be visible, but the smallest particles of such like matter, by the cohesion of a number of which the apparent ones are composed, and therefore they should rather have been called *bony corpuscles*.

AND by the same *phænomena* it seems to be demonstrable, that the ossifying juices are secreted and conveyed to the parts designed to be by them generated or accreted, thro vessels peculi-

arly formed for that purpose ; and that they are by the force of the circulation pushed on to the beginning of the vessels prepared to receive reflux juices, which, as appears by the obstruction in some measure of part of the circulating fluids, in a place beginning to ossify, being so small, as to permit only the finer and more aqueous parts of this juice to enter and pass forward, the grosser consequently must be left behind ; by which means their particles approaching nearer each other, have their attractive force so increased, as sufficiently to draw one another into a cohesion strong enough to form small hard corpuscles, much in the same manner as the particles of salt attract one another, and unite, so soon as a sufficient quantity of the water, in which they were suspended, is evaporated.

AND as it is well known by *Ruych's* experiments, that the blood is capable of forming fine membranes, it seems to be much more consistent with the appearances of nature, to suppose those membranous parts of a bone, which act as a *gluten* to keep these particles and fibres

fibres together, if there be any such, that do not arise from the coats of its vessels, to be produced by a cohesion round the cretaceous particles of a part of the fluid, in which they were generated or contained, than to reckon them parts of the cartilage, in which the bone first becomes visible; because it is very plain by inspection, that as the bony particles are deposited within dilated vessels, the coats of those vessels prevent the cartilaginous substances ever coming into contact with most of those particles.

LET us now examine the objections, Objections consider'd. which may be raised to what has been advanced, especially the chief arguments made use of to support the vulgarly received notion of the cause of ossification; the most material of which is drawn from the supposed change of cartilages into bones, which often preternaturally happens, in both young and ancient people, and is frequently mentioned, as an indisputable proof of the natural tendency of that substance to become bone.

BUT the frequent ossifications of muscular, tendinous, and membranous substances, as well as cartilaginous, shew
no

no more peculiar property to be in the cartilaginous substance to turn bone, than in any other. On examination of any of these preternatural productions, whether they be in muscular, tendinous, membranous, or cartilaginous parts, and whether they seem to be bony incrustations, as they most frequently do, or otherwise; the bulk of the part is never lessened, where the ossification is, but always appears sufficiently augmented to prove, past all dispute, that there had been a quantity of matter, proportionable to its increase or alteration, deposited in or upon it: which demonstrates even these preternatural ossifications not to be produced, as has been supposed, by an expression, or an exhalation of the more liquid part of the substance about to ossify, in order to make way for its earthy and more solid particles to approach near enough together to acquire the hardness, and cause the appearance of a bony substance; because if it had been in that manner generated, the bulk of the part must necessarily, by ossifying, have been greatly diminished, the bulk and weight of all animal substances, except bone, depending

ing indisputably much more on their fluid, than solid parts.

THE pretended reduction of bones into cartilages by steeping them in vinegar, which causes what remains of them to become flexible, and while wet very soft, has been urged as a proof to support the common opinion of bones being originally cartilaginous. But this experiment is so far from shewing that the bony substance is liable to be changed, or reduced to a cartilaginous one, that, on the contrary, it proves all those cretaceous parts to be intirely taken away, which the vinegar could penetrate to. For what remains of a bone after it has been some time in vinegar, is only its membranous part, which the acid cannot operate on, as it does on the cretaceous, which it soon dissolves by fermentation.

By the many experiments of this kind, which I have made on fœtal bones, I find those which are most solid lose, by lying a sufficient time in vinegar (which was often changed, because the bones destroyed its acidity) rather more than two thirds of their weight. And the most

most spongy, which are the bodies of the *vertebræ*, lose very near four fifths; so that the great loss of weight in this operation shews, that the essential part of a bone is destroyed, and not changed, as was supposed. And the membranous substance, which is left behind, is so far from having the resemblance of a cartilaginous one, that it is always very spongy, whereas a perfect uniform solidity is a constant and never failing property of all true cartilages.

BUT tho this experiment does not prove what was designed by it, yet it serves to confirm, what I have as yet only hinted at, that bony fibres and particles are surrounded and kept together by membranes; for if a foetal rib, or any such like bone, be lacerated according to the course of its fibres, after it has been steeped in the manner just mentioned, and then dried, you'll see many bony particles, which were by the acid, but in part dissolved, to be contained within membranes, out of which you may then easily shake them.

SINCE

SINCE the effects of a chemical process have been mentioned (tho, as I have shewn, to little purpose) as an argument to prove all bones to be originally cartilaginous, it will not be improper for me to observe, that I have found by calcination, which is another chemical process, the most solid part of full grown foetal bones, to contain, of terrestrial parts, not to be destroyed by the fire, six out of eleven; which is only one part of eleven less in quantity of earth than I found to be contained in the most solid parts of adult bones; but of such like earth in foetal cartilages, I could not find, by the same method, so much as one part of an hundred. I will not from hence attempt to draw any consequences, because I am sensible they would unavoidably be liable to some objections; but I'll leave it to your consideration, whether it is either possible or probable, that a substance, which is composed of so great a quantity of earth, or fix'd matter, should be generated by the induration of one which contains so very little.

By way of objection it will, I do not doubt, be ask'd, *what becomes of those*
E *carti-*

cartilages in which bones are generated, if they be not by induration, compaction, or some other method, transmuted into bony substances?

THO to some it may seem a difficult task to give a satisfactory answer to this question ; yet to those, who with proper care examine the cartilaginous parts of differentaged *fœtuses* and children, during the gradual progress of the ossifications, which are generated within them, it will plainly appear, that those cartilages, by the great influx of various fluids into them, and the continual increase of the bony substances, are so extended, or spread out, as to lose totally all the properties of cartilages ; and what remains of them becomes in most parts a membrane so exceeding thin, as to be altogether imperceptible : Therefore I think those cartilages may truly be said to be entirely destroyed.

It has been already observed, that almost immediately after such of these species of bones, which are first produced after conception, begin to grow, they increase much faster than the cartilages within which they are contain'd;
con-

consequently they must cause those cartilages, by the constant increasing pressure made on them in their growth, to be gradually extended, and at the same time may hinder the nutritious matter from flowing freely into them, and thereby make them to decrease continually in the same manner, as all other parts of an animal are frequently found to do, so soon as the flux of nutritious juices to them are, by pressure, or any other means whatsoever, either impeded or obstructed.

IT is certain, by only drying foetal cartilages in the open air, they will lose more than four parts in five of their weight: therefore how those substances, by extension, and the exhalation or expression of their fluid parts, may be reduced to such a thinness, as to become altogether invisible, cannot, I think, be difficult to conceive.

THOSE parts which never begin to ossify before eight months after conception, and are not totally ossified until many years after birth, such as the *epiphyses* of the *os femoris* and *tibiæ*, especially when they are much enlarged by five or six years growth, always exhibit, if they

36 HUMAN OSTEOGENY.

are slit while very fresh, so beautiful a view of the manner in which this species of ossification increases, and at the same time of the decrease of the cartilaginous substance, that contains it, as cannot by words be described, or, without seeing, truly conceived : for by such preparations some of the cartilaginous substance plainly appears to be so far from being transmuted into a harder one, that a small part of it may be perceived, in some of the spaces between the irregular bony shootings of these parts, to be so extended by the influx of a reddish thick fluid into it, as, together with that fluid, to have the appearance of a very soft substance, so much resembling a medullary one, as makes me imagine it to be the marrow, or what generates it, contain'd in a membranous bag, form'd by the extension of the cartilage.

It may be further queried, *why any bone or bony substance is generated within a cartilage, if that substance in no degree affords matter to cause its production or accretion ?*

THE answer to this question will be obvious from the account you will hereafter

after have, of the time, when each bony part of a foetal body is generated. For by that it will appear, nature never produces, in any part of the body, a bony substance, as long as a less hard one of equal magnitude can, with like benefit to the creature, supply its place.

THEREFORE, in order to keep a proper symmetry and proportion, at all times, in every part of a foetal body, it was absolutely necessary those places, in which bones were afterwards to be generated, should be filled with a cartilaginous substance, the solidity and hardness of which being nearer to that of bones, than any other in an animal, is consequently the most proper to supply their places.

THUS you will find, the spine, that is chiefly designed to support a weight, which for several months after conception is so inconsiderable, as not to require a substance so hard, as a bony one, to perform that service, continues for a very considerable time, either altogether, or in part cartilaginous, and does not become perfectly bone in every part, until after birth, at a time when a
softer

38 HUMAN OSTEOGENY.

softer substance would apparently be incapable of performing the natural functions of those bones.

THE cartilage also in these parts serve, as has been already mentioned, as a bed for the bony fibres to shoot secure from any impediment, or injury, they might be liable to receive from the motion of the *fœtus*, or external pressure. As for the same purpose nature provides in many parts *callus's* after fractures, as well as to fix the ends of some bones together, before the bony particles begin to be deposited, because, without such a substance, those particles would continually be subject to have their situations varied, not only by the motions of the part, but also by the constant pressures arising from the different actions of the circumjacent muscles; and consequently their union would be liable to be frequently impeded, and sometimes intirely prevented.

THE consideration likewise of the use of those bones, which are form'd between membranes, help us to the reason, why they are never surrounded by cartilaginous substances, and are the

the first generated and perfected. For we find most of these bones, even when their ossifications are far advanced, to be either so exceeding thin, or so very small and slender, that a cartilaginous substance of their size could not have much more solidity, than the membranes, between which those bones are produced; and while the *foetus* is so small, the motions of it cannot be sufficient in any degree to impede the natural progress of the ossifications. As for example, we find the clavicles and ribs to be ossified, even when they are so small, that it is demonstrable, from the consideration of the use they are designed for (which is to keep the *thorax* always sufficiently dilated, and thereby secure the motions of the heart from all manner of impediments and obstructions, they might be liable to from the collapsing of the sides of the *thorax* by pressure) that no other animal substance but bone of their size cou'd be sufficient to perform that office.

HENCE, to conclude, you see by a careful and accurate examination of the various appearances of nature in the bony parts of foetal and young bodies,
in

in what manner it will always be manifest to diligent inquirers, that there is not one single *phænomenon* to support the notion of bones being nothing but indurated cartilages, or that they are produced only by a transmutation of a cartilaginous substance. And that there are a sufficient variety of *phænomena* to afford autoptical demonstrations, that the blood, or a fluid secreted from it, is capable of producing bony substances, without first forming cartilaginous ones. It likewise appears, that the most material arguments, drawn either from the natural or preternatural effects of ossification, which have been used to support the common hypothesis, may, with much more reason, be used to overturn it, and to prove that all bony productions, whether natural or preternatural, are caused intirely by the apposition of cretaceous matter, suspended and brought in a fluid to the ossifying part, and there deposited.

HUMAN



HUMAN OSTEOGENY.

LECTURE II.



ACCORDING to what I proposed, I am now to give an exact description of the apparent difference, there is naturally to be perceived, between the parts of a fresh or undried skeleton of a full grown *fœtus*, and those of an adult; and also to mention, at what time, and in what manner, each part increases and varies from its formation to the time of birth.

IN performing this part of my undertaking, I shall, according to the most general custom of anatomists, divide the skeleton into head, trunck, and extremities; and I propose to make use of such names only, under which the adult bones

F

have

42 HUMAN OSTEOGENY.

have been commonly described, altho I shall often be obliged to give the descriptions of two or more very distinct bones under one name; because a foetal skeleton is divisible into many more parts, than an adult.

I BEGIN with the bones of the head, which are divided into two general parts, those which form the *cranium* or skull, and those which make the greatest part of the face.

The *cranium*.

THE bones of the skulls of *foetuses* are not joined by futures, but are kept together chiefly by the membranes that cover both their sides, each of which membranes is distinguished by a particular name; the internal one being called the *dura mater*, and the external the *pericranium*. Some have reckoned these two membranes to be distinct from the *periosteum* of the bones they cover; but, as the membrane, that they call the *periosteum*, is no easier separable from either of these membranes, than the inner part of the *periosteum* of the shin bone or thigh, is from the external; and as the *periosteum* of most parts may be divided into so many distinct membranes as these
two,

two, I therefore am convinced, that neither the *dura mater* nor *pericranium* is any thing more than a common *periosteum*.

BEFORE the superior part of the *cranium* becomes bony, the *dura mater* and *pericranium* are strongly attach'd together, and so continue, until by the growth and spreading of the bones, that are generated between them, they become gradually separated, which does not happen wholly until many months, and in some subjects several years after birth. For, on the forehead, between the tops of the frontal bones and part of the anterior and superior edges of the *syncipitals*, and on the *occiput*, above the upper angle of the broad or triangular part of the occipital bone and part of the posterior edges of the *syncipitals*, there are in most *fætuses* two openings; the one called the *frontal fontanella*, *pl. i. fig. 1. b.* the other the *occipital*.

NATURE's design in causing the frontal opening always to remain until after birth, and also the loose connexions of the bones of this part of the head to continue as long, was no doubt to permit by pres-

sure, at the time of delivery, a considerable diminution of the skull's circumference, in order to facilitate birth.

THE reason, why but little of the occipital *fontanella* continues until birth, is, *because*, as the great and accurate anatomist *Morgagni* * rightly observes, *there is much more danger from pressing the cerebellum than the cerebrum*; therefore, as far as was necessary, nature has provided against it, by making this opening at that time so small.

THE superior and external part of the skull, at birth, is convex and very smooth, *plate i. fig. 1.* but, its inferior and external part has many inequalities to afford convenient places for the rise and insertions of muscles, which are not near so large, in proportion to the size of the skull, or so numerous, as in adults, *fig. 2.*

ITS internal superior part is concave, and almost as smooth as the external. For the bones being loose, so easily give way to any force, that the blood-vessels cannot press sufficiently on them to cause such deep impressions or furrows, as

* *Adversar. Anat. ii. Animad. 32.*

are generally formed soon after they become fix'd by their futures to each other. The basis, or inferior internal part, does not seem, while covered by the *dura mater*, to differ much from an adult.

THE greatest part of these bones do not, like adult ones, consist of two tables and a *diploe*, or *meditullium*, but almost every part of them is thin, and composed only of a few *laminæ* with scarcely any cellular substance between them.

THE skulls of all aged *fætuses* are much larger, in proportion to the size of the trunk and limbs, than the skulls of adults: and in very small *fætuses* the *fontanellæ* are both considerably bigger in proportion to the size of the head, than at birth, especially the frontal one, which is continued quite down to the nose; and none of the bones are sufficiently formed to touch one another scarcely in any part, and consequently, have openings or vacancies between them, most of which begin to disappear about six months after conception.

A FULL grown foetal *cranium* is divisible into more than twice as many parts

parts as an adult one: for the *os frontis* is always divided into two distinct bones, and the *occiput* composed of four parts, which are joined slightly together by cartilages; the *ossa temporum* are each likewise separable into three bones, which are distinguished by the names of *os squamosum*, *petrosum*, and *annulare* or *annulus*. The *os sphenoides* also is formed by three very distinct ones, connected together chiefly by membranes, and the *os ethmoides* composed of three parts, two of which are bony, and one entirely cartilaginous; so that, together with the *ossa parietalia*, the number of parts of the *cranium* are twenty, without reckoning the four small bones of the ear.

Os frontis.

THE first of these bones to be described is the *os frontis*, so called from its being in adults the only bone of that part of the face and skull. At birth it consists of two very distinct bones, *plate i. fig. 1. a. a.* which in most subjects afterwards become so perfectly united, as to have all the appearance of a division totally obliterated.

THESE two bones touch one another about half of the length of their inner
sides,

sides, from the nose upwards; then they turn off in a curve from each other, leaving a space between them, which is the inferior part of the *fontanella*.

THE small jettings out, or risings, at each corner of the eyes, which, though scarcely perceivable in adults, have been thought considerable enough to have the names of *angular apophyses* assign'd them, are now as visible as ever afterwards; as are likewise those processes, which are commonly called *nasal*, from their being situated at the top of the nose, and forming a small share of its upper part.

THE curved ridges, that run in each bone from one corner of the eye's orbit to the other, which, from the eye-brows being placed on them, are called *superciliary arches*, are now much thinner and sharper than they are afterwards, *fig. 1. c.*

THE protuberances over these arches are much more considerable than at full growth, altho there are not so much as the beginnings of the frontal *sinuses* now to be seen.

THE orbital processes, which run from the under part of each superciliary arch backwards almost to the bottom of the orbit,

orbit, and form almost all the superior sides of the orbits, are now each nearly of a triangular form, *fig. 1. e.*

BETWEEN these orbital processes, within the *cranium*, there is always a vacancy, which is filled up by the middle or horizontal part of the *ethmoides*, and the inferior part of its process, called *crista galli*.

THE perforations on the external surfaces of these bones are not near so numerous as those on adults. The hole or notch on each superciliary ridge, thro which a twig of the opthalmic branch of the fifth pair of nerves passeth, with a small artery from the *carotide*, are always apparent at birth, *fig. 1. d.* But the holes, thro which the nasal twigs of the first branch of the fifth pair of nerves pass, which are generally formed by these bones and the *ossa plana*, are not now to be found.

THESE two bones are by membranes join'd to themselves, or some part or other of each bone of the skull, except the *ossa petrosa* and *os occipitis*; and in like manner they are connected to the *ossa lacrymalia*, *maxillaria*, and *nasi*, which are bones of the face.

THE

THE reason why nature form'd the bony part of the forehead of *fætuses* thus different from adults, was probably to permit, on an extraordinary occasion, a considerable diminution of the skull's circumference by these two bones lapping over each other, which we sometimes find to be occasion'd by difficult births, without a fatal inconvenience to the child.

BETWEEN two and three months after conception these bones begin to be form'd, just above the middle of the superciliary ridges.

* KERCKRINGIUS's account of their bony fibres shooting from the circumference of each to its center, is intirely false; for they always begin, as I have mention'd, above the superciliary ridges, and in the same form he describes in that place, *supra orbitam se prodit semilunaris quædam ossea substantia*. Then the bony fibres shoot toward the circumference directly, contrary to what he affirms; and there never are cartilages in the middle or any part of them, though

* Osteog. Fœt. Cap. ii.

50 HUMAN OSTEOGENY.

he describes and delineates them to continue until six months after conception.

AT first they appear thinner than the membranes they are contained in. About three months great part of the superciliary arches are form'd, and a small part of the orbital processes, *fig. 4.*

ABOUT four months they begin to have somewhat of the shape full grown *fœtuses* usually have, *fig. 3,* their interior edges do not then touch one another, but form an acute angle just above the nose.

FROM five months to nine there is not any very remarkable variation except the gradual decrease of the aperture between them.

Ossa syncipitis.

THE bones of the *synciput*, which are often called *ossa parietalia*, from their serving on each side of the head as a defence to the brain, and *ossa bregmatis*, from some share of the *fontanella* being between part of them, are one on each side of the head. They are of an irregular form, in *fœtuses* somewhat different from adults, *plate i. fig. 1. f. fig. 5.* Their superior sides join one another; at each end of which the bones are rounded,

ed, in order to form the superior parts of both the anterior and posterior *fontanella*. The middle of their lower sides makes curves, which go just above and round the semicircular parts of the *ossa squamosa*, and then they are stretched out forward a little over the temporal *apophyses* of the *os sphenoides*, *fig. 1. g.* and backward over the cartilages, which join them and the *ossa petrosa* together, *fig. 2. g.* Their external surfaces differ not much from adults, except in the risings about the middle of each bone, which are now much larger, in proportion to the size of the head, than they are afterwards, and the substance of the rising is much more solid, and polished, than any other part. The internal surfaces are pretty smooth, and seldom have any furrows impressed in them by the blood vessels.

BETWEEN two and three months after conception, these bones begin to be generated, in the manner I have already mentioned, *fig. 7.*

AT four months, in their middle the resemblance of the irregular net-work continues to be apparent, and near the

circumference the fibres begin to be very distinct and visible, *fig. 6.*

ABOUT five months, the protuberances about the center of each bone become visible, from whence the fibres shoot like *radii*.

AT six months, they have the shape of full grown foetal ones, *fig. 5.* and differ only from them in the solidity of their substances, and smoothness of their surfaces; for from this time the *radii* gradually grow less distinct, until they disappear.

Os occi-
pitis.

THE *os occipitis* at birth consists of four bones, join'd together by cartilages, *plate 1. fig. 2. m. p. p. q.* The upper bone or part is by much the largest, and has somewhat the resemblance of a spherical triangle. Its shape, in different *foetuses* of the same age, varies more than any other bone of the head. In some subjects, at its superior angle, there is a division almost quite down to its middle, *fig. 8. m.* in others there is only a notch, and sometimes it is rounded, without either notch or slit. In many there is at each of the lateral angles a long slit running up toward the middle of the bone,

bone, *fig. 8. n. n.* in others there is only a notch.

ON the middle of the external surface of this bone, there is a protuberance much greater, in proportion to the size of the part, than is usually to be seen on adults, under which there are sometimes two hollows, divided by a small rising.

THE inner surface is more concave than generally in adults. And on it there is often, from the end of the superior slit, a channel quite down to the middle of the bone, *fig. 8. o.* The ridges and cavities, which in adults are very considerable, at this time only begin to be visible.

WHEN the slits at the lateral angles are very short, there are usually deep channels, from their ends, almost up to the bottom of the superior channel.

ABOUT the center of this bone internally, there are generally one or two holes, which I never found now to penetrate thro the bone, as they have been described to do in adults.

AT the upper angle of this bone is the posterior *fontanella*, in which sometimes at birth are found small bones, commonly

commonly called *ossa triquetra*, or *Wormiana*. In the skull, *plate i. fig. 2. s.s.* you see two such bones, that are very distinct, one of which is almost as big as the largest that are usually found in adults. Hence, I think, it is reasonable to suppose, all such like bones, which are often to be seen about the futures of adult ones, are generated in the same manner as these appear to be, and not caused, as has been suggested, by accidental fractures of small parts of those bones near which they are situated.

THE connexions of this bone to others are partly membranous, and partly cartilaginous. Those of its upper sides, which are join'd to the hinder sides of the sincipital bones, are entirely membranous ; and those of its inferior side, which are fix'd to the hinder parts of the *ossa petrosa*, and to the second and third bone of the *occiput*, are connected by an intervening cartilage, as well as membranes, *fig. 2. n. n. i. i.*

THIS part of the *occiput* begins to ossify, between two and three months after conception, at its inferior part, which, after the superior part is generated, is always

ways much the thickest, and has the resemblance of a thick bony incrustation, which continues as long as the upper part remains thin, and resembles a curious piece of net-work, *fig. 11. a. b.*

KERCKRINGIUS * says, this bone, about three months after conception, is generally divided into three or four parts. Whether or no it is ever so divided, I will not pretend to determine; but I never observed any other division in it, than what was occasion'd by my carelessness in separating the *dura mater* and *pericranium* from it.

BETWEEN four and five months it acquires much the same shape full grown foetal ones have, *fig. 10. a.* altho the superior part is much thinner than the inferior, and the Incrustation on it remains.

AT six months the inferior part is thinner, in proportion to the thickness of the superior, than it was before, and then has not the least appearance of incrustation. The opening at the top of this bone now begins considerably to decrease, and so continues to do until birth,

* Osteog. foet. cap. iv.

when

when it is generally very small. From this time to birth the variations in this part are very inconsiderable.

THE second and third bones of the *occiput* are exactly alike, and are not now perfectly ossified, tho very nearly so, *fig. 2. p. p. fig. 9. p. p.* On the external and anterior part of each bone, where by a small cartilage it is join'd to the fourth, there is a large protuberance, covered with a cartilage, which, together with a less one of the fourth part of the *occiput* that is connected to it, forms what is called one of the *condyloide* processes of the *occiput*, which now are rather smaller in proportion to the size of the part, than in adults, *fig. 2. o. o.* The holes under these processes are much the same as in adults.

THE internal parts of these bones are concave, and have several small perforations, which vary in different subjects, *fig. 9. p. p.*

THE sides and ends of these parts not being perfectly ossified, are consequently join'd by cartilages, as well as by the membranes that cover them, to the *ossea petrosa*, and the other bones of the *occiput*,

put, by all which bones their external edges are surrounded, *fig. 2. n.n. l.l. fig. 9. n.n. r.r.*

THE fourth bone seems to me to be the hinder part of the *os sphenoides*; because, before the ossifications begin, the place of this, and the body of the *sphenoid* bone is always filled with one cartilage, in which the ossifications constantly begin in various points at some distance from each other, which in time are united in one; but, as it has been usually reckoned a part of the *occiput*, I shall consider it as such. It is often called the *cuneiform* process of the *occipital* bone. Externally it does not differ greatly from an adult, *fig. 2. q.* except at its *condyloide* processes, which are much smaller. The cavity on its interior side, in which is lodg'd the *medulla oblongata*, is not near so deep, at birth as afterwards, *f. 9. q.*

IT is connected at the *condyloide* processes, by cartilages, to the first and second bone of the *occiput*, *fig. 2. r.r.* and its anterior side joins the cartilage at the hinder part of the body of the *os sphenoides*.

H

THESE

58 HUMAN OSTEOGENY.

THESE four parts of the *occiput* jointly form the great *foramen*, thro which the *medulla oblongata* passes out of the skull, *fig. 2. t.*

BETWEEN two and three months after conception, the places of the first and second *occipital* bones are entirely filled with cartilages, but the fourth has a small ossification in it.

ABOUT three months the ossifications in the first and second parts begin pretty near the middle of each, and increase gradually in the same manner, until each part becomes entirely bone; which generally happens in the *cuneiform* process between four and five months; but in the other parts, tho the ossifications seem almost perfected at six months, yet they are not wholly compleated until after birth.

Offa temporalium.

EACH of the *temporal* bones at the time of birth is compos'd of three parts, besides the small bones of the ear, which, as has been mentioned, are distinguished by particular names.

Os squamosum.

THE superior one, called *os squamosum*, is a thin, broad, and almost semi-circular bone, externally smooth, and a little

little convex, *pl. i. fig. 1. b. fig. 12. b.* It has a considerable process, call'd *zygomatic*, that rises at the inferior part of the bone just above the *annulus*, *fig. 1. i. fig. 12. i.* from whence it stretches forward to the process of the *os malæ* of the same name. It is much slenderer in *fætuses* than in adults, and much less curved. Under the root of this process there is a shallow oblong cavity, lined with a very thin cartilage, *f.* which in adults is much deeper, for the reception of the *condyloide* process of the under jaw. The tubercle situated just before this cavity, on which the under jaw plays, when it is by the external *pterygoide* muscles drawn forward out of the cavity, is now scarcely perceivable.

BETWEEN the hinder and lower part of the cavity, and the annular bone, there is a fissure, thro which passes that branch of the fifth pair of nerves, which, within the *tympanum*, is called *chorda tympani*, *fig. 2. b.*

THE internal part of this bone is a little concave, *fig. 13. b.* and its superior part pretty smooth. Near its bottom there is a small ridge, which runs cross part of the bone, and by which the *os*

petrosum is join'd to it, much in the same manner, as *epiphyses* are join'd to the bones they belong to, *fig. 13. i. i.* Just above this ridge there is a small hole, which is not to be found in adults, *l.* The part below this ridge is rough, and in its hinder part there are small *cancelli*; it forms the exterior and upper side of the cavity, in which the small bones of the ear are contained, *plate ii. fig. 8. m.*

THE semicircular edge of this bone does not lap over the inferior side of the *os parietale* now, as it does soon after birth. At its anterior side it is spread a little over the temporal process of the *os sphenoides*, and its hinder side also laps over the *os petrosum*, above the place, where afterwards grows the *mastoide* process.

Os petrosum.

THE inferior part of the temporal bone is called *petrosum*, from its general hardness in adults. Even at the time of birth many parts of it are harder than most of the other bones; altho its solidity and hardness gradually increase, until it arrives at maturity, when it becomes the hardest part of the body, except the enamel of the teeth.

A

A GREAT part of the *petrosum* is not form'd at birth, particularly the large and thick *apophysis*, which is called *mamillaris* or *mastoidæus*, in the place of which, there is not so much as a cartilage; but the part, from which it afterwards shoots, flants from the *annulus* upward to the cartilage, which now fills up the space between this bone and the *occiput*, *pl. i. fig. 2. l. l. fig. 12. l.*

THE *styloide epiphysis* of this bone, *fig. 14. a.* which is situated just behind the posterior part of the *annulus* near its hinder end, and just before the hole, which is called the *aquæductus Fallopii*, *b.* is, at birth, and a long time afterwards, wholly cartilaginous. In *fætuses* it always lies almost close to the skull, cross the *meatus auditorius externus*, with its end or point towards the *fauces*, in which position it continues some months after birth.

I ONCE found both these *epiphyses* thus situated in a child turn'd of four years of age, which could not speak any word distinctly. From whence I conjectured, their positions might be the chief, if not sole cause of the great impediment

pediment the child had in its speech; because as these *epiphyses* are of a considerable length, the distances of the origins of those muscles, which rise in them, and are inserted into the tongue, must be considerably less, and consequently, the force of their actions much varied, when they lie almost flat in the manner I just mention'd, than when they are situated almost at right angles with the *petrosus*, which are the usual or natural situations of them under four years of age, as well as at maturity.

THE *os petrosus* has four sides, two internal, which are within the *cranium*, and two external, which are without it.

ON the external sides there are several remarkable perforations, besides the large passage to the ear, which is perfectly covered by the *membrana tympani*, and surrounded by the bony ring, *fig. 12. n.o. o.o.* That hole which is on the superior side, just behind the root of the *styloide epiphysis*, which is the passage of the *portio dura* of the auditory nerve, and is usually called *aquæductus Fallopii*, is of an irregular form, and in proportion to
the

the size of the *fœtus*, larger than in an adult, *fig. 14. b.*

THE large hole on the inferior external side, which first ascends directly, and then runs forward, and penetrates at the end of the bone (not into the *cranium*, thro which pass the internal *carotide* artery, and the beginning of the *intercostal* nerve) is generally rather less than in adults, *fig. 2. v.w. fig. 14. d.e.* The inferior external side has also several small cavities in it, with many small perforations, and often a slender sharp process, *fig. 14. c.* which is generally broke in cleaning the bone.

THE superior side, beyond the annular bone, where the *mastoide* process afterwards grows, is pretty smooth, and has many small perforations, *fig. 2. l.l.*

AT the anterior end of this bone, just above the passage of the *carotide* artery, there is the opening of an irregular shaped tube, which runs backward into the cavity of the ear, known by the name of *tuba Eustachiana*, so called from the greatest and most accurate anatomist of his time, *Eustachius*, its first observer. It opens into the *tympanum*, just under that
part

64 HUMAN OSTEOGENY.

part of the *annulus*, which is next the small process of the *sphenoides*, *fig. 2. x.* Its end next the *fauces* is cartilaginous.

THE internal sides of this bone, which are within the skull, are in shape very different from adults, *fig. 13.* The superior side is not divided from the inferior by a sharp ridge, which in adults is continued from one end of the bone to the other, but by a thick round one, which about the middle ends at the great hole, that runs under the superior semicircular canal, *fig. n.* from which another thick ridge runs back, and, as it approaches the end of the bone, grows pretty sharp, *p.*

ON these sides there are two large perforations, the anterior and inferior of which is called *meatus auditorius internus*, *fig. 13. o.* which soon divides into two, one of which is the beginning of the *aquæductus Fallopii*, the other soon ends in several ducts, which afford passages to the *portio mollis* of the seventh pair of nerves into the *vestibulum* and *cochlea*; thro it also an artery passes. This *meatus* is larger, in proportion to the size of the bone, than in adults.

ABOVE

Above and behind the *meatus inter-nus* is a larger hole *n*, which, tho at birth is so considerable, in adults is often scarcely visible, and never half as big. It has over it a large round ridge, which, as has been mentioned, is the upper semicircular canal *m*. From the bottom of this ridge, or a little lower, there is another somewhat less, within which is the inferior semicircular canal, and under that a small perforation.

ON the upper side of the bone there is a long hollow or *fulcus*, in which are sometimes a few small holes, observed by *Valsalva* *, but never to be seen in adults. About the middle of this *fulcus* there is a hole larger than the rest *r*, and a little more forward than that, just below the *fulcus*, there is the opening of the *canalis Fallopii*, *f*.

THE cavity on the inferior side, in which the *sinus lateralis duræ matris* ends, is not near so deep or large as in adults *q*. Under the inferior semicircular canal there is also a hollow which is not to be found, when the bone is full grown.

* De Aure.

THE most hinder part of the *petrosum* is not perfectly form'd at birth, but has about it a cartilage, by which it is join'd to part of the *os parietale* and *occipitis*, *fig. 12. k. fig. 13. k.*

AT two months after conception the *os squamosum* is not begun to be form'd, but the *petrosum* is altogether cartilaginous, and with proper care the *styloide epiphysis* may then be found.

ABOUT three months the *squamosum* is partly generated, and its *zygomatic* process is so much form'd, as to reach almost the same named process of the *os malæ*, *plate ii. fig. 6.* But the *petrosum* is yet wholly cartilaginous.

AT four months the *squamosum* is a little increased, *fig. 2. a. fig. 5.* and the *os petrosum* is begun to ossify, *fig. 4.* But the shape of it at that time is very different from what it has at birth, *fig. 2. b. b. fig. 3.*

ABOUT five months the *squamosum* is so enlarged, that it touches the temporal process of the *sphenoide* bone, and almost reaches the *parietal*, and its *zygomatic* process is entirely form'd. The *petrosum* has then an ossification near the
foramen

foramen rotundum, and also one, and sometimes two others, in the hinder part of it, near the *canales semicirculares*.

AT six months the different ossifications in the *petrosum* are united, *plate ii. fig. 1.* and the beginning of the *tuba Eustachiana* is form'd *a*, as also a small part of the *carotide* duct; but the hinder part of the bone is yet mostly cartilaginous *b*.

AT seven months the greatest part of the *petrosum* is generated and ossified, except at its posterior end, there is a cartilage, *fig. 9. k.* which gradually lessens, but is not totally gone until after birth; and at the hinder end of the inferior and external edge of the *squamosum* there remains a thin cartilage almost as long.

WITHIN the *os petrosum* are contained the little bones and other parts of the organs of hearing, to which there are two passages already taken notice of; but the *annulus*, or bony ring, which surrounds the great aperture to the *tympanum*, remains to be described.

THO this bone has the name of *an-* *Annulus.*
nulus, or *circulus*, its two ends do not meet, but are join'd at a small distance from each other to the *os squamosum*,

68 HUMAN OSTEOGENY.

the anterior end generally close to the root of the *zygomatic* process, and sometimes a little beyond it, and the posterior at the end of the inferior edge of the *squamosum*, where it joins the *petrosum*, plate i. fig. 2. y. z. It is a narrow bone, externally a little convex, and internally has a *fulcus* or groove in it, to the edges of which is fixt the *membrana tympani*, plate ii. fig. 12.

AT birth it is join'd by membranes to the edges of the aperture it furrounds. At its anterior end, on the internal ridge, there is a process, which touches the neck of the *malleus*, and is by a membrane join'd to it, fig. 8. n. Both its ends I have found in some subjects perfectly united to the *squamosum*, in others only the anterior one, and sometimes neither.

BEFORE three months after conception this bone is form'd, and then is almost as fine as a hair; and between three and four months it is very elastic, and may, by freeing the ends of it, be flipt out of the duplicature of the *membrana tympani*, as out of a sheath, fig. 14. From this time it gradually increases, and grows less elastic,

ON

ON the edges of the *annulus* is stretch-^{Membrana tympani.} ed a double membrane, well known by the name of *membrana tympani*, plate i. fig. 12. n. plate ii. fig. 8. a. At birth these membranes are easily separated. *Val-salva* says, the internal one is a production of the *dura mater*; and the external, a membranous expansion of the skin that lines the *meatus auditorius externus*. But to me they seem both to arise from the membrane, that lines the *cavitas tympani*; for the external is a continuation of the internal, which, when raised near the *annulus*, manifestly appears to be continued round that bone to the internal, and the bone to be contain'd in, or surrounded by the two membranes. The internal membrane may always in *fœtuses*, with proper care, be traced to that which lines the *tympanum*.

THE injections of the great *Ruyfch* has put it past dispute, that these membranes are well supplied with blood-vessels. But in *fœtuses*, and very young infants, the *membrana tympani* is covered by a peculiar white tegument, analogous to a membrane, plate i. fig. 12. m. which *Ruyfch* found to have no blood-vessels, and

and therefore was by him supposed to be a continuation of the cuticle. But, *Du Verney* thought it was only a mucilaginous substance, indurated into a membrane. To me it seems to be partly mucilaginous, and partly membranous; because the external part of it, which is always white and soft, may be easily washed away, or rubb'd off from the internal part, which may, with care, be traced to the cuticle, or membrane, that lines the *meatus*.

VALSALVA supposes this membrane to be often the cause of deafness, when it does not come away, which he thinks might be relieved by surgery.

THE use which nature designs it for, probably is to prevent, for some time after birth, sounds operating much, if at all, on the organs of hearing.

THE situation of the *membrana tympani*, in *fœtuses*, is not near so horizontal, as that of adults. It is always kept stretched by the handle of the *malleus* pulling it inward, by which is caused externally a large *conoide* cavity.

THAT this membrane sometimes has a perforation in adults, is past dispute; but

but whether there should naturally be one, I much question ; because, by the many experiments I have made, I never yet could force air, either thro the external *meatus* into the *cavitas tympani*, or thro the *Eustachian* tube into the *meatus*.

IN *fœtuses* under five months the two membranes, that form the *membrana tympani*, are almost wholly separate; the internal one making, together with the membrane that lines the *cavitas tympani*, a sort of bag, in which the small bones of the ear are contain'd, and the external membrane is but loosely stretched, and is not pulled inward by the *malleus*, *plate ii. fig. 2. c.*

WHEN the *membrana tympani* is removed, the small bones of the ear are ap-
The bones of the ear.
parent, which are next to be described. They are four in number, known by the names of *malleus*, *incus*, *os orbiculare*, and *stapes*, *plate ii. fig. 7.* At birth all these bones are very little less than at maturity, *fig. 15. fig. 17. fig. 19.* and scarcely at all differ from adults, except in the solidity of their substances.

THE

Malleus.

THE head of the *malleus* is hollow, and the substance of the neck, small process and handle are cellular, *fig. 16.* all which in adults are solid. The cartilage, that covers that part of the head, which is articulated with the *incus*, appears to be a little thicker than at maturity, and the long process is a little thinner than an adult one, *fig. 7. a fig. 15. a.*

Incus.

THE body and legs of the *incus*, or anvil, are hollow, *f. 18.* The cavity on its head, in which is received the head of the *malleus*, is lined with a cartilage, which, tho very thin, is thicker than in an adult. At the top of its short leg there is a small cavity, which in adults is scarcely visible, as there is also in the same leg a small roundish one, in which a ligament is fixt.

THE *os orbiculare*, *fig. 17. c.* is so small, that its existence has been often questioned. At birth I cannot discover any difference from the adult, except in its articulation, which then is so loose, that, before it is dried, it may be plainly perceived, by moving the bone gently with your finger.

THE

LECTURE II.

73

THE *stapes*, so called from its resemblance of a stirrup, is not now so perfectly of that shape as it is at maturity. *Stapes.*

IT is not difficult in *fœtuses* to discover the *periosteum* of these bones, tho it is much finer than the *periosteum* of the other parts; therefore I think it strange that so many authors should report them to have none.

IT is almost three months after conception before any of these bones become visible. At three months, what is form'd of the *malleus* is entirely cartilaginous, as is all the *incus*, except at the top of its long leg, where there is sometimes a small ossification. The head of the *stapes* is a little ossified.

AT four months the head of the *malleus* is a little ossified, and its long process, which then appears like a fine hair, but is not more than the tenth of an inch long, and the little process also is ossified; but the neck and handle are then cartilaginous. The head of the *incus* is partly cartilaginous, as also the extremities of both its legs. The *os orbiculare* is just visible. The bottom of the legs of

K

the

the *stapes* is cartilaginous, but the basis is ossified.

AT five months the head of the *malleus* is perfectly ossified, as are likewise all its other parts, except its neck and handle. The *incus* is all ossified, except at the extremity of its short leg. The *os orbiculare* is yet cartilaginous. The *stapes* is perfectly ossified.

AT six months all parts of these bones are ossified, and differ from full grown ones only a little in size, except the *stapes*, the body of which is then much rounder than it is afterwards.

AT three months after conception these bones touch the sides of the cavity they are contain'd in, which cavity is not so large, in proportion to the size it afterwards grows to, as these bones are. At both three and four months, the long leg of the *incus* and the handle of the *malleus* almost touch one another, which afterwards gradually recede from each other. The body and short leg of the *incus* at four months just touch the external semicircular canal, from which afterwards, by the increase of the cavity, it is gradually removed. At the same time,

time, the head of the *stapes* is very near the cavity, which contains its muscle ; but at five months, and afterwards, that cavity is removed further from it.

ALL these bones, from their first appearance, until almost six months after conception, seem to be closely enveloped by the membrane that covers the *cavitas tympani*, and forms the inner part of the *membrana tympani*. But when the cavity becomes much bigger, and the bones at a greater distance from its sides, then part of that membrane forms ligaments, by which the head of the *malleus* and the *incus* and its short leg are fixt to the sides of the cavity ; which ligaments are, so soon as form'd, much the same to appearance as in adults, except in their length, in which respect they increase a little, as the cavity enlarges.

WE now come to examine the various cavities contain'd within the *os petrosum*, which are part of the organs of hearing.

THE largest and most considerable of *Tympanum*. these is call'd the *tympanum*, or drum ; it is divided into three parts, the anterior, posterior, and middle.

76 | HUMAN OSTEOGENY.

THE anterior is that, in which the *tuba Eustachiana* opens, and where the canal of the *musculus internus mallei* is situated, by *Du Verney* called *semicanalis*, which in the *fœtus* runs straight from the *foramen ovale* to the orifice of the *Eustachian* tube, and is much narrower than in adults.

THE hinder part of the *tympanum*, commonly called *cavitas* or *sinuositas mastoidea*, is at birth much less than in adults; because the *mastoide apophysis*, in which a great part of it is afterwards contained, is not then generated.

THE middle of this cavity, in which the small bones of the ear are contain'd, is less at birth than at maturity, especially its inferior part; the cells or small caverns of which are not then near so numerous or large, as they are afterwards. All the protuberances in it are considerably smaller. The *foramen ovale* is as long, tho not so wide. The *rotundum* is rounder than in an adult, and turn'd more toward the *membrana tympani*. The small bony fibres, which in adults may be seen going from the inferior side
of

of the cavity to the protuberance of the *cocblea*, I never found in *fætuses*.

A FULL grown foetal *cocblea* is rather Cocblea & canales semicirculares. less than an adult, *pl. ii. fig. 10. a.* but the *canales semicirculares*, *b. c. d.* are much of the same size, except at their openings, which seem to me to be somewhat larger.

THE membrane or *periosteum*, that lines all the cavities of the ear, is at birth exceeding fine, tho it is much thicker than it is at maturity.

THE cavity of the *tympanum* in *fætuses* of two months, is scarcely visible, and the *membrana tympani* lies almost flat on the *petrosus*; for the small bones are then imperceptible, but the *foramen ovale* and *rotundum*, and the *semicircular canals* and *cocblea*, tho very small, may be perceived.

AT three months the cavity of the drum is form'd, but the protuberances in it are hardly visible, except that of the *cocblea*, which touches the *membrana tympani*. Both the *foramen ovale* and *rotundum*, tho very small, are, in proportion to the size of the *cavitas tympani*, much larger than in an adult, and they both are parallel to the *membrana tympani*.

78 HUMAN OSTEOGENY.

pani. The rim of the *foramen rotundum* is then ossified. The figures of the *cochlea* and *canales semicirculares*, tho now cartilaginous, are much the same as in a full grown *foetus*.

AT four months the cavity of the drum is much enlarged, and the beginning of the *cavitas mastoidea* is formed. The protuberance of the *cochlea* is then ossified, and is at a greater distance from the *membrana tympani*.

AT five months the upper side of this cavity is much increased, and the inferior begun to be generated. The *canales muscoli Fallopii, Eustachii, and stapedis*, are now ossified.

AT six months the cavity is wholly ossified, and is pretty much enlarged, from which time it gradually increases; and about seven months the small cells or caverns in it begin to be generated, and the *foramen ovale* is much the same as at nine, but the *foramen rotundum* is not then turned toward the inferior side of the cavity, as it is in the next month, *plate ii. fig. 7. c. fig. 9. a. b.*

Os sphenoides.

THE next bone to be described, which is common both to the face and skull, is called

called *sphenoides*, or *cuneiforme*, plate ii. fig. 20, 21. This has the greatest variety of parts, distinguished by different names, of any bone in the body. At birth it consists of three distinct bones, connected together by membranes and cartilages, which afterwards become inseparably united. The middle, or thickest part, by which it joins the *vomer* before, and the fourth bone of the *occiput* behind, I shall call its body, fig. 21. *a. a.* the hinder part of which is now cartilaginous, fig. 20. *c.* and as for the two bones, which are join'd on each side to it, I shall, as *Ingrassias* does, describe them under the names of the great wings of the *sphenoides*, *b. b.* I begin with the body, on both the external, as well as internal parts of which are several considerable *apophyses*.

INTERNALLY, there are two sharp transverse processes, call'd the little wings of this bone, fig. 20. *g. g.* These form the hinder part of the upper side of each orbit, and the upper sides of the superior orbitary fissure, and are now ossified, tho their figure differs a little from adults. The anterior sides of these *apophyses* are loosely

loosely connected by membranes to the hinder sides of the orbital processes of the frontal bones. In the middle between them there is a notch *h*, in which is received part of the *os ethmoides*.

BEHIND the little wings there are four other processes, called *clinoides*; the two anterior are now ossified, *f. f.* but the posterior are entirely cartilaginous, *d. d.* Between these processes is a cavity, generally called *sella Turcica*, *e.* which is all bone, except a small share of that part of it, which joins the posterior *clinoides*, where it is cartilaginous.

EXTERNALLY, on the middle and fore part of this bone, there is a thick rising, which is the root or beginning of what is usually called the *azugos* process of this bone; because it has not a fellow, as all the other processes have, *fig. 21. d.* The lower part of it is now received into the hinder part of the *vomer* by *schindylesis*, and the top of it is joined to the nasal *lamella* of the *os ethmoides*. At birth it is far from being perfectly form'd, but in some subjects it is much more so than in others.

ON each side of this body there is an *apophysis*, to which is fixt one of the great wings,

wings, which *apophysis* is stretched out backward toward the *cuneiform* process of the *occiput*, *fig. 20. i. i.*

ON each of the great wings of the *sphenoides* are four *apophyses*, distinguished by the names of *temporal*, *orbital*, *pterygoide*, and *spinal*.

THE temporal process makes part of the temples, under the *zygomatic* process of the *os malæ*, and the anterior part of the same named process of the *os squamosum*, *plate i. fig. 1. l. plate ii. fig. 21. e.* It joins the hinder edge of the *os malæ*, and runs a little under the anterior one of the *squamosum*. Its superior edge is not grown enough to touch either the frontal or sincipital bone, but there is a small aperture between them, in which aperture, *plate i. fig. 1.* you may see the beginning of three *ossa Wormiana*.

AT the lower and back part of this process, there runs out a spinal one under the *condyloide* cavity of the *os squamosum*, in *fætuses*, almost quite to the annular bone.

ON the anterior edge of the temporal process, is join'd almost, at right angles, the orbital process, which forms a

L

great

great part of the hinder side of the orbit, the superior edge of which is very loosely join'd by membranes, that cover it, to part of the external side of the orbital process of the *os frontis*, plate ii. fig. 21. f.

AT the bottom of the temporal and orbital processes is the *apophysis*, called *pterygoides*, or *aliformis*, from its supposed resemblance to a bat's wing, plate i. fig. 2. d. It is divided into two *alæ*, the internal of which is very much less, in proportion to what it is in adults, than the external. The cavity between these *alæ*, in which the internal *peristaphyline* muscle rises, is not formed, but the hook at the top of the internal *ala*, e. round which plays the tendon of the just named muscle, is perfectly generated.

THE number of perforations, thro which considerable nerves and blood-vessels pass, are in a full grown foetal *sphenoid* bone the same as in adults, and differ only from them a little in their magnitude, which is generally greater, in proportion to the size of the bone, than in adults: But those small holes at the bottom of the *sella Turcica*, are oftner
more

more in number and larger than in adults, *plate ii. fig. 20. e.*

AT birth there is only the beginning of the large cavity, which in adults generally is to be seen in the body of the *sphenoide* bone, and then it is almost filled with cartilage.

AT two months after conception, the place of the *os sphenoides* is supplied, partly by membranes, and partly by cartilage, the body being entirely cartilaginous, and the great wings not generated.

ABOUT three months the great wings begin to appear, and three specks of ossification are to be seen, one in the body, and one in each of its small wings, *plate ii. fig. 25. a. b. c.*

ABOUT four months the great wings are much increased, and there are now six ossifications in the body; two in the little wings, which are now pretty long, two in the anterior *clinoide apophysis*, and two in the *sella Turcica* : so that at this time, as *Kerckringius* rightly observes, this part consists of eight distinct bones, besides cartilage, *fig. 24.*

AT five months the great wings are almost form'd, and the little wings are

84 HUMAN OSTEOGENY.

near ossified, and a considerable part of the body is become bone.

AT six months the great wings have almost the same shape they have at birth, *fig. 22.* except the inner *ala* of the *pterygoide apophysis*, the beginning of which is then scarcely form'd. The little wings are entirely ossified, *fig. 23. g. g.* except at their roots, *b.* where they join the body of the bone, and are much broader, in proportion to their size, than they are a month or two afterwards. The middle of the body of the bone *e.* is ossified, as are its lateral processes, to which the great wings are join'd, *ii*; but its *azygos* process is cartilaginous, and its *clinoide* processes, *d. d. f. f.*

ABOUT seven months the ossifications are almost as much compleated as at nine.

Os Ethmoides.

THE last bone, which is common to the face and *cranium*, is the *ethmoides*, which is situated in the middle and fore part of the skull. At birth it is composed of various parts, some of which are ossified, and others intirely cartilaginous.

THAT part, which is placed horizontally between the orbital *apophyses* of the frontal

frontal bones, which is always full of small holes, from whence it is called *lamella cribrosa*, is entirely cartilaginous, as is also that part of it, which is called the nasal *lamella*, plate ii. fig. 26. a. from its making the *septum nasi*, and the process commonly call'd *crista galli* b. which passeth thro the middle of the *lamella cribrosa* into the cavity of the skull.

THE parts of it, which are called *ossa spongiosa*, or *turbinata superiora*, are pretty much ossified, especially where they join one another, f. 28. a. but their posterior parts gradually decrease in breadth, and end in two very slender cartilages. The substances of these ossified parts are rather more spongy than in adults.

ON the external sides of these bones, there is a thin smooth *lamella*, called *os planum*, fig. 29. b. which makes part of the inner side of the orbit: This now is almost surrounded by a cartilage, which runs under part of the orbital process of the superior *maxillary* bone and the *os unguis*, a. a. a.

AT four months after conception the *os ethmoides* is altogether cartilaginous; but the ossifications of the *ossa plana* begin

86 HUMAN OSTEOGENY.

gin soon after, and at six months they are as much ossified as at nine; as likewise by the same time, or soon after, are the *ossa spongiosa*, altho they do not begin to ossify by near a month so soon as the *plana*, *fig. 30.*

THE bones of the face are now to be described, which are divided into those of the upper and inferior jaw.

THE number of the bones of the upper jaw are the same in full grown *fætuses* as in adults, except the teeth, which I never found at the time of birth to exceed twelve in number.

Ossa nasi. THE first of these bones are the *ossa nasi*, so named from their situation at the superior part of the nose, *plate i. fig. 1. m. plate ii. fig. 28. c.* They are at birth so perfectly form'd, as not to differ scarcely at all in their external surfaces from adults; but on their internal sides they are rougher and more porous.

THEIR connexions, above to the nasal *apophyses* of the frontal bones, and laterally to the same named processes of the upper *maxillary* bones, and to one another, are loose, and altogether by membranes.

THESE

THESE bones, by the fourth month after conception, are generally as much form'd, in proportion to the bigness of the *fœtus*, as at nine. They ossify, and acquire the shape they usually have at birth, when they are so small, that it is impossible to observe the manner of their production.

THE *ossa unguis* are situated at the in- *Ossa unguis*
ternal corners of the orbits, *pl. i. fig. 1. n.*
They are at birth perfectly ossified. The side of each of them next the orbit is as smooth as the *os planum*, and its substance much the same; but the side next the *nares* is rough, *plate iii. fig. 1.* Its anterior part, which has a *fossa*, or groove, in which the lachrymal bag and part of its duct is contained, from whence it has the name of *os lachrymale*, is full of small holes, and is very thin and brittle.

THESE bones are joined to the *ossa frontis* and *maxillaria superiora* by membranes, and to the *ossa plana* both by membranes and cartilages.

ABOUT four months after conception they are so small and thin, as to be scarcely visible to the naked eye.

BETWEEN

BETWEEN five and six months, they are partly ossified, and between six and seven months, they are almost as much form'd as at birth.

Ossa malarum.

THE *ossa malarum* are two irregular shap'd bones, with four corners or points. At birth they differ very little from adults, except at their ends and sides, where they have not, like adults, indentations for their better and stronger connexions with other bones; but are loosely joined by membranes to the bones they touch.
plate i. fig. 1. o. plate iii. fig. 2.

AT three months after conception the *ossa malarum* begin to be generated, and have, by the fourth month, nearly the usual shape of full grown foetal ones, and are perfectly ossified, *fig. 3.*

Ossa maxillaria superiora.

THE *ossa maxillaria superiora* are the largest bones of the face, *plate i. fig. 1. p. fig. 2. a. a.* The external parts, which form the greatest share of the upper jaw and bottom of the orbit, do not differ very much in shape from adults.

THE nasal *apophysis* of each bone is rougher, *plate i. fig. 1. q.* and has, on that part of it next the orbit, just before the edge of its inner side, a shallow groove,
in

in which are several small holes. The top of the nasal *apophysis* does not end square and rough, like adults, but is rounded off, *plate iii. fig. 4. a.* and does but just touch the frontal bone, to which it is loosely join'd by membranes.

THE orbital process is more concave and porous at birth than afterwards, *fig. 4. b.* There is then the appearance of a future along the middle of that part of the bone, which covers the canal, thro which passes the second branch of the fifth pair of nerves.

THAT part of the bone, which is hollowed for the reception of the *os malæ*, *fig. 4. c.* and is covered by it, is full of small holes, and has higher edges and sharper, without indentations, than adults usually have, and at the bottom or extremity of it, there are not any risings or many inequalities. Under the orbit the bone is thin and porous.

THE internal part of the *os maxillare superius* may be divided into two parts, that which forms the anterior or greatest part of the palate, together with the sockets of the teeth, *plate i. fig. 2. a. a. 1, 2, 3, 4, 5.* and that part which makes

M

the

the bottom and side of the *nares*, *pl. iii. fig. 5. e. e. e.*

THE first mentioned part is situated horizontally, the upper surface of which makes at least three fourths of the bottom of the *nares*, and the inferior surface as much of the palate. It is much thinner, and as porous as in adults. At its anterior part there is a future, extended cross the palate, generally from the internal edge of the *dens caninus* on one side, to the same edge on the other side, *plate i. fig. 2. b.* Just before the middle of this future is the *foramen incisivum*, much larger, in proportion to the size of the bone, than in adults. The divisions of the sockets of the teeth are but few, and exceeding thin and brittle. The side of this bone, next the *nares*, is almost covered by a thin bony *lamella*, under which slides part of the *os palati*.

THE *antrum Highmorianum* is pretty large, *plate iii. fig. 5. f.* tho not so big, in proportion to the size of the bone, as in adults; no part of it is now covered by the *os palati*, as it is afterwards. The passage for the lachrimal duct is small, *b.*

THESE

THESE bones are connected to one another, along the middle of the roof of the mouth by *symphysis*, above which connexions, within the *nares*, is fixt the bottom of the *vomer* on a very small ridge, much less, in proportion to the size of the part, than in adults.

ABOUT three months after birth a great part of these bones is form'd, but scarcely any cavities for the teeth.

AT four months they have pretty near the shape of full grown foetal ones, *pl. iii. fig. 7.* and at the future, which is at all times of life visible cross the anterior part of the roof of the mouth, each bone is generally divided into two distinct parts, from between the *dentes canini* and *incisivi* up to the bottom of the nose. The horizontal part now has the bony *lamella* on its superior surface.

BETWEEN five months and nine there is but little variation, except in the gradual forming of the rim of the orbit and the *foramen* just under it, called *orbiter externus*, the lachrimal duct to the *nares*, and the *antrum Highmorianum*, the beginning of which last is generally visible about the seventh month, tho ma-

ny have reported it not to be so until some time after birth.

Offa palati
ii.

THE *offa palati* are situated at the hinder part of the *nares* and palate, of both which they make not more than a fourth part; tho in *fætuses* they are larger, in proportion to the length of the palate, than in adults, *plate i. fig. 2. c. c.*

THE anterior end of the horizontal part of this bone is received between the two bones of the horizontal part of the *os maxillare superius*, *plate iii. fig. 5. i. fig. 6. b.* and at the time of birth it receives the hinder edge of the same part of that bone into a shallow groove.

THAT part of it, which is called its nasal *lamella*, *b.* and runs up the posterior part of the side of the *nares*, is very thin and brittle; at the top of it there is a process, in some subjects square, *fig. 4. d.* and in others long, *fig. 6. d.* which makes a small bit of the orbit, quite at the end of its inferior side, under which process there is not such a hollow or cavity, as is generally to be found in adults.

AT the external and hinder corner of the palate, there runs out a process on the external side of the *pterygoide* process of the

the *os sphenoides*, which is much sharper than in adults, *fig. 6. a.*

THESE bones are joined to one another in the same manner as the palate-part of the maxillary bones are, and have in like manner also the *vomer* fixt on them.

BEFORE three months after conception, these bones begin to be generated, and have nearly the same shape of full grown foetal ones, when they are so small, as rarely to be separated from the membranes, in which they are contained, without being broke.

THE *ossa spongiosa inferiora* or *tur-*<sup>*Ossa spon-*
giofa.</sup>*binata* are situated at the inferior part of the sides of the *nares*, under the same named part of the *ethmoides*, and are at birth about as much form'd as they, *plate ii. fig. 28. d.* They are connected to the *ossa maxillaria superiora* by the membranes, that line the *nares*, and cover them.

IN these parts I have never found any ossifications, until near five months after conception, and then the ossifications increase so fast, as to be almost as much perfected at six months as at nine, *fig. 31.*

THE

Vomer.

THE last bone of the upper jaw is the *vomer*, so called from its supposed resemblance to a plough-share, *plate ii. fig. 26.c.* All that is form'd of it, are two thin porous bony *lamellæ*, joined together at their inferior sides, *d*, where the bone is by *symphysis* connected to the ridge, which, as has been mentioned, runs along the middle of the bottom of the *nares*. It receives all the bottom of the *septum nasi* between its two *lamellæ*, and behind, at its posterior end, it receives the bottom of the middle and anterior process of the body of the *sphenoide* bone, *pl. i. fig. 2. f. 6.*

BETWEEN three and four months after conception, it has much the same shape as a full grown foetal one usually has.

Lower jaw.

THE lower jaw, always at birth, consists of two bones, joined together at the middle of the chin by membranes, *pl. iii. fig. 9. a. a. b.* where they are afterwards so perfectly united, as not to have the least appearance of a division.

THE hinder process of each of these bones, by which it is articulated with the *os squamosum*, is now much shorter, in proportion

proportion to the rest of the bone, than it is in adults, *c. c.* The intervening cartilage of this articulation has more the resemblance of a thick ligamentous membrane, than of a cartilage.

THE hinder side of the anterior or *coronide apophysis*, into which the *crota-phyte* muscle is inserted, is much shorter than in adults, *d. d.*

EACH of these bones is composed of two thin sides, join'd together at their bottom; the interior is much more compact and smooth than the exterior, which is very porous, and unequally thin.

BETWEEN these sides is a large cavity, divided by thin bony *septa* into five cavities, 1, 2, 3, 4, 5. in which are contained the teeth in their bags. At the bottom of this cavity runs a large branch of the fifth pair of nerves, and an artery which goes to the internal part of the bone, and affords a branch to every tooth-bag; there is also a vein which runs to the jugulars. The part of the cavity, in which the *dentes incisivi* and *caninus* are contained, is not so deep as that which contains the *molars*, by reason of the bottom of the bone under them

them being thicker than in any other part. The holes on the chin are more backward than in adults.

THESE may be reckoned among the earliest generated bones ; for they begin to be form'd before two months after conception.

AT three months the *coronide* process is visible, *fig. 11. d.* and the beginning of the sockets of the *dentes incisivi* ; but the inner side of the bone is not produced higher than the bottom of the cavities for the *dentes molares*, *a.* These bones are now almost straight, their anterior ends being not yet curved.

KERCKRINGIUS * affirms the *coronide apophysis* to be always a distinct bone at three months. But I have never yet met with any subject of that, or any other age, in which I did not find this process as much united to the bone as any other part of it.

AT four months the sockets for the *incisivi* and *canini* are formed, from which there is a long shallow cavity without any partitions, *fig. 12.*

* De Osteog. fact.

BETWEEN five and six months these bones begin to be curved, and the inner side is almost as much generated, as the outer.

FROM between six and seven months to nine, they vary little, except in thickness and curviture, *fig. 10.*

WHAT remains of the head to be de- Teeth.
scribed, are the *teeth*, which, always at birth, and for many months after, are buried within the jaws.

WHAT, at birth, is formed of each of them, is only a fine thin hard shell, in the shape of the superior part of an adult tooth, *plate iii. fig. 14, fig. 15, fig. 16, fig. 17.* which seems to be the beginning of their enamel. Within this shell is contained a peculiar soft red substance, which easily slips out of it, and retains exactly its shape. Each of these shells is contained in a distinct bag, which is strongly united to the gum, *fig. 13. a.a.a.* The number of these bags I never found to exceed six on a side, *b.b.b.b.b.b.* each of which is, at birth, contained in a distinct socket, or bony cavity of the jaw, except the two hindermost, which have no bony partition between them. In

N

the

the bags there is always to be found, besides the teeth, a mucilaginous substance.

No bony part of the body is so uniformly solid, or near so hard, as this part of the teeth is in its infancy, in proportion to its thickness.

THERE is not at birth, as *Eustachius* * imagin'd, the least appearance, that I cou'd ever find, of the layer or row of teeth, by which the first is afterwards usually thrust out.

BETWEEN four and five months after conception, the points of these shells are generated, at which time they are so small, as to be easier felt than seen.

ABOUT six months, they have almost the same shape as full grown foetal ones usually have, *fig. 18. fig. 19.* except the *molars*, which are often in three or four parts.

THE long time, which nature takes before she perfects any of these parts, after they are begun to be generated, seems to be designed to produce their great hardness and solidity, by a very slow and gradual, tho constant, apposition of new matter. And the very early decaying of such teeth, which, by incisions, have

* *Opuscula de dentibus.*

been

been permitted to penetrate the gums, some time before nature intended they should, makes it, I think, manifest, that all the time they are naturally contain'd within the jaws under the gums, is absolutely necessary for the true and perfect formation of their external part, commonly called their *enamel*, from the supposed resemblance it has to such a vitreous substance.

I would by no means have what I just mentioned, to be the cause of teeths decaying very soon, tho it is certainly true, to be ever used as an argument to dissuade any from cutting infants gums, especially when violent and dangerous symptoms appear; because I have often seen children, dying, as was imagined, receive immediate and great relief by that operation, even when their gums did not appear in the least to be swelled. But the method of drawing the teeth of children between five and seven years of age, if they are in the least rotten, and sometimes, as I have more than once seen, even when they are perfectly sound, which is thought by many people necessary to cause the second set of teeth to

grow even and uniform, ought to be never used, altho what is intended by it may generally be produced; because, by some experiments I have had reason to think, that the enameled part of a tooth never increases after it has penetrated the gum. And, I believe, it will always be found to be fact, that those children, who cut and shed their teeth the latest, constantly have the best, and such as continue the longest in perfection; therefore the pulling out of the first teeth, before they are loosen'd by the second, must cause the second to shoot out of the jaw before they otherwise would, and consequently before they are compleatly formed.

Os hyoides. BEFORE I come to consider the bones of the trunck, there remains a little bone to be described, called *os hyoides*, plate iii. fig. 20.

KERCKRINGIUS * gives no description of it, and the reason he alledges for his so doing, was, *non quia Galenus illud in libello de ossibus præteriit, sed quia in fœtibus ne quidem cartilago ejus appareat.* Hence it is plain, he had not with pro-

* Osteog. fœt. c. ii.

per care sought for it ; because, at birth, it never has less than three distinct ossifications, *fig. 20. a. a. b.* and its figure is much the same as that of adults, and, in proportion to the size of the *fœtus*, much of the same magnitude. Each of its horns then is joined to its body by a ligament, which makes a sort of articulation, *c. c.*

IN *fœtuses*, under three months old, its place is always filled with a cartilage of the same form.

UNDER the age of eight months, I never found any ossification in it ; but soon after that time it begins to ossify in the middle of its basis, *fig. 22. a.* and before nine months, there are two points of ossification generated in each of its horns, which, by the time of birth, generally unite, and form a long bone above half the length of the horn, *fig. 21. a. a.*

I AM now to consider the bones of the second division or part of a skeleton, which are those that compose the trunk. They are divided into three parts, those of the *spine, thorax, and pelvis.*

THE

The spine.

THE *spine* is that congeries of articulated bones, which reach from the bottom of the *occiput* to the extremity of the rump; the number of which in *fœtuses* is thirty three, and sometimes thirty four.

THE twenty four superior of these bones are called true *vertebræ*, seven of which belong to the neck, twelve to the back, and five to the loins. Those below the loins are called false *vertebræ*, the five superior, and sometimes six, belong to the *os sacrum*, and the four inferior to the *os coccygis*, *plate iv. fig. 1. fig. 7.*

THE *vertebræ* in *fœtuses* are very different from adults. For, except the first of the neck, which consists of two bones only, and the second and last, which have more, all the true *vertebræ* have three bones joined together by cartilages.

THAT which now forms the body of each *vertebra* is a thick, flat, cellular bone, *fig. 11.* surrounded almost by cartilages, except at its anterior part, which has a cavity, that is covered only by the strong and thick membrane, which is extended over all the external parts of the bodies of the *vertebræ*.

ON

ON each side of the body of each *vertebra* there is a bone, which runs backward, and is joined to its fellow on the other side by the cartilage, which is in the place of the spinal *apophysis*, *fig. 6. a. a. d.* These I shall call the lateral bones of fœtal *vertebræ*. On their anterior ends are the processes, which are called transverse, *c. c.* and oblique, *e. e.* The transverse processes of the *vertebræ* of the neck, which are perforated at birth, have only their posterior sides formed by these bones, all the anterior being then cartilaginous, except the last, which generally has a small bone on its anterior side, join'd to the posterior by cartilage, *fig. 4. c. c.* The transverse processes of the dorsal *vertebræ* are, except just at their ends, entirely bone, *fig. 5. c. c.* but the lumbar are more cartilaginous, *fig. 6. c. c.* The oblique processes of all the *vertebræ* are bone, covered with a very thin cartilage, and in *fœtuses* much alike.

THE first *vertebra* of the neck, which *Vertebræ of the neck.* is called *atlas*, *fig. 2.* has its anterior part entirely cartilaginous, *b.* and its two lateral bones are joined behind together by a cartilage, which is in the form of an arch,

arch, *d.* The superior part of the anterior ends of the lateral bones are hollow, and covered with a thin cartilage, by which the greatest part of the cavity, wherein the *condyles* of the occipital bones are received, is formed, *e.e.* The transverse processes of this *vertebra* are larger than all the rest, except the last, *c.c.*

THE second *vertebra*, commonly called *dentata*, from its tooth-like *apophysis* on its body, *fig. 3. b.* is always at birth composed, besides cartilage, of at least four bones, and often five or six. One forms its body, on which is another separated only by a cartilage, that makes the root and great part of the body of the tooth-like process, and two lateral bones, the hinder ends of which are join'd together by a cartilage. On each side of the body, at the root of the anterior side of each transverse process, there is often a small round ossification, which sometimes is only on one side.

THE other five *vertebræ* of the neck never have more than three bones in each at birth, except the last, which, as has been mentioned, has a little bone on the anterior side of its transverse processes,
that

that makes the number of its bones to be five.

THE forkedness of the cartilages of these *vertebræ*, which are in the place of their spinal processes, *fig. 7.* decrease gradually as they descend, and the last sometimes has scarcely any, *fig. 4. d.* and sometimes ends in a point like the dorsal.

THE dorsal *vertebræ* are all alike in form, but in size they vary from each other much in the same proportion as full grown foetal ones. The transverse processes are not so long, in proportion to the size of the *vertebræ*, as in adults, but are roundish, and topp'd with a round cartilage, *fig. 5. c.* The inferior edges of their lateral bones have join'd along them a narrow thin cartilage, *fig. 7.* and the cartilages, that are in the places of their spinal processes, end in acute angles, which lie flat, pointing downward, *f. 7.*

THOSE parts of these *vertebræ*, on which the ribs are articulated, are entirely cartilaginous.

THE lumbar *vertebræ* consist of three bones like the dorsal, their transverse *apophyses* are short, and mostly form'd by cartilages, *fig. 6. c. c.* The
O posterior

posterior ends of their lateral bones are broad and round, furrounded by a narrow cartilage, *fig. 6. f. f.* and is a continuation of that which is in the place of the spinal process, *d.* that ends in a fork pointed downward, above which there is a cartilaginous ridge.

Os sacrum.

THE parts of the *os sacrum* are at their bodies articulated together, much in the same manner as the true *vertebræ*; but their transverse *apophyses* are all so join'd together by a cartilage on each side, which runs the whole length of the *sacrum*, gradually decreasing in its thickness, until it becomes very small, *fig. 1. a. b.* that these false *vertebræ* cannot, like the true ones, be separated by only removing the ligaments of their articulations, without cutting these lateral cartilages.

THE two superior false *vertebræ* always, and often three, have their lateral bones joined at their posterior ends by a cartilage, much of the same form of those which are in the place of the spinal processes of the dorsal *vertebræ*, *fig. 7.* The two superior parts also have, in their transverse processes, small ossifications, by which their bony parts are made five
in

in number ; but the other three or four parts have never more than three. The lateral bones of the two lowest parts always, and sometimes three, are not, at their posterior ends, join'd by cartilage, but by a membrane.

ON the posterior side of that part of each lateral cartilage, which is connected to the transverse spines of the two superior parts, there is an uneven shallow cavity, in which are received the small protuberances on that part of the *ilium*, which by *symphysis* is joined to the *os sacrum*.

NONE of these false *vertebræ* have oblique processes, except the superior, where it is articulated with the last *vertebra* of the loins.

THE four last bones of the spine, *Oscoccygis.* which form the *os coccygis*, and in adults are not only often united together, but also with the *os sacrum*, are at birth generally four distinct cartilages, *fig. 1. 31, 32, 33, 34.* tho once or twice I have seen in the two superior a small ossification at that time. The superior is pretty large and flatish, the second is somewhat less, and the two last are pretty nearly of a size, and almost round.

108 HUMAN OSTEOGENY.

THE passage for the *medulla spinatis* along the spine in *fætuses* is much of the same size, in proportion to the magnitude of the *fætus*, as in adults ; but the holes between the transverse processes of the *vertebræ* are much larger.

AT two months after conception the spine is generated, and part of its processes, all which are then entirely cartilaginous.

VERY soon after three months, there are ossifications in all the bodies of the *vertebræ*, except in the first of the true, and the five inferior of the false, *fig. 12*. About the middle of the dorsal *vertebræ* the ossifications are the largest, and gradually decrease from thence, both as they ascend to the top of the neck, and as they descend to the *os sacrum*.

THE lateral bones of the first *vertebra* are pretty much ossified ; from thence the ossifications of all the other lateral bones of the spine gradually decrease, until it is in those of the lowest lumbar *vertebræ* so small, as scarcely to be perceptible.

AT the fourth month the ossifications of the lateral parts of all the *os sacrum* are begun.

AT

AT the fifth month there are ossifications in every body and lateral part of the *os sacrum*.

AT the sixth month the ossification in the tooth of the second *vertebra* of the neck is begun, and the anterior side of the transverse process of the last *vertebra* of the neck is often now ossified, as also all the roots of the same processes of the dorsal *vertebræ*.

AT the seventh, sometimes, and generally the eighth month, there are small points of ossification in the transverse processes of the upper part of the *os sacrum*, and often in the same places of the second.

WHAT are usually called the bones of the *thorax*, are only the ribs and *ster-*
num, tho the dorsal *vertebræ* form the middle of the hinder side of the thoracic cavity.

The bones
of the *tho-*
rax.

IN all *fætuses*, before the lungs have been filled with air, the anterior part of the cavity is much flatter than it is afterwards ; for I have always found then the cartilaginous parts of the ribs almost quite straight, and the lower end of the *sternum* much nearer the spine ;
 which,

which, as soon as the child has breathed, is forced further out, and thereby the cartilages of the ribs are curvated, and consequently the cavity enlarged.

Ribs.

THE ribs in full grown *fœtuses* do not differ greatly from adults, except at their posterior ends, where they are a little more cartilaginous; although their articulations with the dorsal *vertebræ* are exactly the same, and their tubercles perfectly ossified. The *fulcus* for the intercostal arteries, veins, and nerves to pass in, are at birth formed, and the roundness of the superior sides of most of the ribs, and the sharpness of the inferior is in much the same proportion as in adults; but their curvature is not so great, especially that of the false ones.

ALL fœtal ribs differ from one another in the same manner and proportion as adult ones naturally do; therefore it is foreign to my purpose, at present, to relate the particular difference between each of them, *plate iii. fig. 28, fig. 29, fig. 30, fig. 31, fig. 32, fig. 33.*

THE anterior cartilaginous end of the first rib is perfectly united with the superior part of the *sternum*, *fig. 24, 1.*

The

The same ends of the second, third, fourth, and fifth ribs are articulated with the *sternum* in semilunar cavities on the sides of it, *fig. 24. 2. b. 3. b. 4. b. 5. b.* Which articulations are often by age entirely obliterated ; but the same ends of the sixth and last true ribs are generally close to one another, and lie on the fore part of the *sternum*, being there tyed by membranes to it, the ends of those on one side being near those of the other, *fig. 24. 6, 7. c.* The cartilaginous ends of the five inferior or false ribs are connected to the last true ribs, and to one another, by their intercostal muscles, and a pretty strong ligament.

THE internal substance of the ribs is much the same as that of adults, *fig. 25. a. a. a. a.*

BEFORE two months after conception the greatest part of the true ribs are generated and ossified ; and then differ from full grown fœtal ones only at their posterior ends, which are cartilaginous from a little above their tubercle. In the same manner are the false ones, except the last, which is so small, as scarcely

scarcely to be perceived, especially its bony part, if there be any. The articulations of both ends of the ribs are now perfectly distinct, tho *Kerckringius** affirms the contrary.

BETWEEN the third and fourth month these parts are so near perfected, that there appears no material difference in any of them from those of nine months, except in magnitude, *fig. 34. fig. 35. fig. 36. fig. 37.*

Sternum.

THE *sternum* at birth is not curved, as in adults, and always consists of two parts, which are articulated together in the same manner as the cartilaginous ends of the ribs are, which, in all the subjects I have examined, is just at the middle of the articulation of the second rib; where it is articulated both with the superior and inferior part of the *sternum*, *plate iii. fig. 24. a. b.*

THE shape of the upper part of the *sternum* is much the same as that of adults, and has, as I have already shewn, the cartilaginous ends of the first ribs

* Osteog. foet. cap. xiv.

united with it. By the articulation of this part of the *sternum*, there seems to be a motion peculiar to it, and different from the other part; for when the cavity of the *thorax* is dilated, the superior end of this part seems to be pushed inward and depressed, and its lower end pushed outward and raised. On the top of this part are articulated the anterior ends of the clavicles, *fig. 25. c.*

WITH the inferior part of the *sternum* the cartilaginous ends of the ribs, as has been shewn, are articulated; and at the bottom of it there is a process, called *ensiformis*, tho its shape is very various in different subjects, as you see in the preparations, *fig. 24. d. fig. 25. d. fig. 26. d.*

THE greatest part of the *sternum* at birth is cartilaginous, with various ossifications in it, about the number of which there have been many disputes, which I think to have been very trifling; because if those enquirers had examined a variety of subjects, they would certainly have found, that scarcely two different *sternums* of the same age are ossified alike; as in the preparation, *fig. 26.* you see only

P ly

114 HUMAN OSTEOGENY.

ly one ossification in the upper part of it, 1. and three in the lower part, 2, 3, 4. the inferior of which is very small. In the other preparation, *fig. 25.* you find two large ossifications in the upper part, 1, 2. and in the inferior part, there is a large one at its top, 3. and five small ones below it, irregularly situated, 4, 5, 6, 7, 8. Thus you see *Fallopious* and *Bartholin* related the truth, when they reckon'd the number of bones in this part to be sometimes eight; tho * *Kerckringius* seems to have thought their number never to exceed six. I, in one subject not nine months old, found three ossifications in the upper part, and seven irregularly disposed ones in the inferior.

BEFORE two months after conception, the *sternum* is formed, and the articulation of its upper part with the inferior distinct. Its shape then is not materially different from a full grown foetal one; it is then entirely cartilaginous, and so continues generally until the fifth month, when one or two, and sometimes three small ossifications are to be found in it; after which time, you may see, by

* Osteog. foet. c. xv.

preparations, the ossifications are very various.

THE next bones to be described are those of the *pelvis*, commonly called *ossa innominata*. *Ossa innominata.*

EACH *os innominatum* is at birth composed of three bones, join'd, at a distance from each other, by an intervening cartilage, *plate v. fig. 1. a. b. c.*

THE superior part is distinguished by the name of *ilium*, *a.* *Ilium.* It is a broad flat bone, with a semicircular edge, surrounded by a semicircular thick cartilage, of about the breadth of the fourth part of the bone's length, *d. d.*

ITS lower part is fixed in the cartilage, which makes the upper part of the *acetabulum*, *e.* and joins it to the other bones. On the hinder part of its inner side, there is a small irregular cavity and rising, by which it is articulated with the upper parts of the *os sacrum* by *symphysis*. Both the inner and exterior sides are pretty smooth, and are both partly concave and convex.

THE substance of this bone is now much more spongy than in an adult, and

116 HUMAN OSTEOGENY.

is rather thicker, in proportion to its magnitude, *fig. 2.*

Os pubis.

THE anterior part of the *os innominatum* is called *os pubis*, *fig. 1. b.* It is at birth, at each of its ends, cartilaginous, and is not ossified enough to form any part of the *acetabulum*.

Ischium.

THE hinder part of the *innominatum*, called *ischium*, *e.* is, at its superior part, ossified sufficiently to make the hinder part of the bottom of the *acetabulum*, which is the only bony part of that cavity in *fœtuses*. All the inferior and anterior sides of the great *foramen* are cartilaginous.

THE surface and depth of the *acetabulum* is much the same as in adults.

THE connexion of the *ossa pubis* together is by membranes, and in such a loose manner, as to be like an articulation, capable of permitting a small degree of flexion.

A LITTLE before three months after conception, the *os ilium* is partly ossified, but the cartilaginous rim is broader than the bone; all the rest of the *innominatum* is cartilaginous.

AT

AT three months, or a little after, these parts have almost the shape of full grown foetal ones, altho the ossifications are not begun in either of the *ossa ilii* or *ischii*, *fig. 3.*

ABOUT four months, there is sometimes to be found a very small ossification, near the top of the *ischium*, *fig. 4. a.* and about the fifth month the *os pubis* begins to ossify, from which time the ossifications of these three parts gradually increase until birth, without much varying the figure of the whole *os innominatum*.

I AM now come to describe those parts of the skeleton, which to anatomists are known by the names of its superior and inferior extremities.

THE superior extremities consist each of them of four parts, the shoulder, the arm, fore-arm, and hand.

THE shoulder is formed by two bones, the *clavicle* and the *scapula*.

THE *clavicle*, which is situated at the top of the *thorax* transversely, between the *sternum* and the superior *epiphysis* of the *scapula*, is so perfectly ossified at birth, that it differs very little from an adult

118 HUMAN OSTEOGENY.

adult in any thing, except its curvature, which is, I think, generally less, *plate v. fig. 5.* and its articulations, both with the *acromion* and the *sternum*, differ not in the least from adults.

AT one month after conception this bone is begun to be generated and ossify'd, and it is perfected before most of the other parts begin to ossify; and then differs in nothing but magnitude from full grown foetal ones, which is before three months after conception, *fig. 6. fig. 7.*

Scapula.

THE *scapula*, at the time of birth, differs greatly from an adult, *plate v. fig. 8.* The bony rim of its basis, *a. a. a.* is much rounder than at maturity, and is surrounded by a large cartilage, at that part of the *scapula* commonly called its great or inferior angle, *b.* which is now rounded; from whence the cartilage runs almost in a straight line, *b. c.* growing very narrow, until it comes near the bottom of the spine, *c.* where it widens, and makes an obtuse angle, from whence it runs up, and ends at the upper angle above the spine, *d.*

THE two widest parts of this cartilage are true *epiphyses*, the ossifications
of

of which are not perfected until after sixteen years of age.

THE side of this bone next the ribs is not near so hollow as in adults, and is much smoother. The exterior side of it is also smooth, and the hollow, commonly called *cavitas supra-spinata*, is not near so large. What is called its spine does not rise quite so high as in adults, and its end, which is joined to the *epiphysis*, called *acromion*, is not so much curved or rounded, and therefore the edge, from the bottom of the spine quite up to the top, is almost in a straight line, *e.e.* The inferior *costa* of this bone is rounded much in the same manner as in adults, *f.* but the upper *costa* is very thin, and more curved, *g.*

THE *acromion* is a broad flat cartilage, curved inward, *h.* Under the *acromion*, at the upper side of the head of the *scapula*, is another *epiphysis*, called *coracoides*, which is now entirely cartilaginous; this is curved like adults, but ends in a sharper point, *i.* Its thick basis is inseparably united to the cartilaginous head of the bone, which now seems to be an *epiphysis*, tho it is not, *k.k.*

The

The *glenoide* cavity, in which is articulated the head of the *humerus*, is shallower, and at its superior part narrower, than adult ones usually are.

AT two months after conception, the *scapula* has almost the same shape of one of three months, it has a small ossification in its middle, and its *epiphyses* are distinct.

AT four months it differs from full grown foetal ones only in the length of its spine, and the breadth of the cartilage that surrounds its basis, which gradually decreases as the bone increases, *fig. 10.*

Os humeri. THE second part of the upper extremity consists of one bone, called *os humeri*. It is at birth straighter than in an adult, *pl. v. fig. 11.* and from its top, *a.* for near three fourths of its length, it gradually lessens, and then widens again, and grows flatish, *b.* On the external side of its lower end is a large deep cavity, *c.* in which is received the superior *epiphysis* of the *ulna*, called *olecranon*, when the fore-arm is extended. But at birth the anterior side of this end of the bone is convex, and has not, as in adults, a
cavity

cavity for the reception of the *coronide epiphysis* of the *ulna* in the flexions of the fore-arm, nor the small cavity for the head of the *radius*; and therefore the bone in this part is not near so thin, in proportion to its size, as it is after it arrives at maturity. The surface of the bone is smoother, and more even than in adults, and has but one furrow in it, which is caused by the tendon of the *biceps flexor cubiti*.

At each end of the *os humeri* there is an *epiphysis*, both which at birth are entirely cartilaginous. The inferior is almost exactly of the same figure that part is usually of in full grown bones, *e*. but the superior, which makes the head of the *humerus*, is much narrower at its external side than in adults, *d*. The *fossa*, in which the tendon of the *biceps* is lodged, is now formed, and has in it many small holes, in the same manner as adults have. The substance of this bone is a little less solid than an adult, and the middle of it is not so hollow, *fig. 14. a. a. b.*

THE ossifications of this bone begin about a month after conception, in the
Q form

122 HUMAN OSTEOGENY.

form of a ring, when it is not thicker than a small pin, and yet the superior and inferior *epiphyses* have much the same shape they have at birth, and are articulated perfectly distinct; tho *Kerckringius* reports the contrary, *fig. 23. a.*

AT three and four months, the difference between the bone and a full grown foetal one is only in the *epiphyses*, which are a little longer, in proportion to the size of the bone, than afterwards, *fig. 17. fig. 19.* but at five months, I find no difference in the shape of it from those of nine.

THE third part of the upper extremity is the fore-arm, which consists of two bones, the *ulna* and *radius*.

Ulna.

THE *ulna* is the longest of the two, and is situated on the outside of the fore-arm, *fig. 12.* It is pretty smooth, and a little more curv'd inward than in an adult. No part of its body is triangular like adults, nor has it any remarkable protuberances or cavities, but is roundish, and at its superior end, *a.* thickest, from whence it gradually decreases almost to the middle of the bone, where it begins to increase again, and grows gradually a little

tle flatter and wider until it ends, *b.* in the inferior *epiphysis*, *c.* which is of the same shape as adult ones, tho now cartilaginous, and has what is usually called the *styloide* process, *d.* from which the ligament goes to the *os pisiforme* or *unciforme* of the wrist.

AT the top of the bone is a large *epiphysis* entirely cartilaginous, in the anterior part of which is a semicircular or sigmoide cavity, suited to the *trochlea ossis humeri*, *f.* The top of it is called the *olecranon*, *g.* the anterior end of its curve is the *coronide* process, *h.* but that process, which in adults makes the corner of the elbow on its hinder part, is not now formed.

THE *radius*, which is situated on the side of the last described bone, has on its superior extremity a round *epiphysis*, called its head, *fig. 13. a.* the top of which is hollowed for the reception of the tubercle of the *epiphysis ossis humeri*, on which it turns. Below this *epiphysis* is the neck, *b.* at the bottom of which is a considerable protuberating process, *c.* in which the *flexor cubiti* is inserted, which at birth is narrower than in adults,

124 HUMAN OSTEOGENY.

dults, and the bone at that place is more bent.

BELOW this process the bone is round and slender down to its middle, *d.* where it begins and continues gradually to increase in breadth and thickness downward, until it ends in a cartilaginous *epiphysis*, *e.* the figure of which is, as well as the part of the bone that joins to it, at birth, a *pentagon*, one side of which is large, two about half as big, and two very small ones; in one of the small sides is a cavity for the reception of the *ulna*.

AT the bottom of this *epiphysis* is an oblong, and now very shallow cavity, divided in its middle, in which are received two carpal bones, called *scaphoides* and *lunare*, *f.*

THE ossifications of the *radius* and *ulna* begin about one month after conception in the same manner as the *os humeri* does.

ABOUT three months their extremities have very nearly the same shape of full grown ones, *fig. 18.*

ABOUT four months they differ not in any thing remarkably, but size, from those of nine, *fig. 20. a. b.*

THE

THE last part of this extremity is the hand, which is form'd by three sorts of bones, those of the *carpus*, *metacarpus*, and fingers.

THE places of the eight bones of the *carpus* *Ossa carpi.* are at birth wholly filled with cartilages, which have much the same shape the bones usually have when they are perfectly generated, *fig. 21. 1, 2, 3, 4, 5, 6, 7, 8.*

THESE eight cartilages are never united in one, as * *Kerckringius* reports, but are always generated distinct, and have the same articulations they have at birth, when they are so small as not to be perceived without the help of a glass.

THE *ossa metacarpi* are four long *Ossa metacarpi.* bones, which have cartilaginous *epiphyses*, the largest of which, *fig. 21. a.* articulate with the carpal bones, the other, *c.* with the fingers; the bones, *b.* are smooth, and a little more straight than in adults.

EACH of the fingers and thumb consist of three bones, *fig. 21. d. e. f.* the figures of which differ not remarkably from adults. They all have, at the ex- *Bones of the fingers.*

* Osteog. feet. cap. xviii.

tremities next the wrist, an *epiphysis* at birth wholly cartilaginous. At the other ends of the first bones of each finger and thumb, there are considerable cartilages, which have been generally thought to be *epiphyses*, but, by preparations a little older, they appear not to have ossifications within them, as all *epiphyses* have, but are gradually spread out until they become only of a thickness necessary for the articulations.

THE bones of the *metacarpus* begin, like the other cylindrical bones, to ossify in the form of a ring round their middle, about two months after conception.

ABOUT four months they differ not much in their shape or quantity of bone, in proportion to their size, from full grown foetal ones, *fig. 20. d.*

THE fingers and thumb begin to ossify in the same manner as the metacarpal bones, but a little later. The first and second *phalanges* are a little ossified rather before three months after conception, but the last is not until four months, *e. f. g.*

ABOUT five months they are all so much ossified, as not to differ from full grown

grown foetal ones in any thing but magnitude.

WE now come to examine the inferior extremities, each of which are divided into three parts, the thigh, leg, and foot.

THE thigh consists of a long bone, *Os femoris*. plate vi. fig. 1. *a. a.* with one large *epiphysis* at its inferior extremity, *b. b.* and three at its superior, *c. d. e.* which, at the time of birth, are united in one cartilage.

THE upper and largest of the superior *epiphyses* is called the head of the thigh bone, *c.* which is like a large portion of a globe, and is always at birth wholly cartilaginous. Pretty near the middle of its convexity, there is a cavity, in which is fixt the *ligamentum teres*, fig. 8. *d.* Round the basis of the head there is a ridge with a small cavity under it, in which the inner coat of the capsular ligament of the joint is fixt.

THE superior part of the process, commonly called the neck of the *os femoris*, is formed by the part of the cartilage, which runs from the upper part of the basis of the head to the great trochanter,

chanter, and makes the bottom of the hollow between them, *fig. 1. f.* The inferior part of the neck is now formed mostly by the top of the body of the bone, *g.* The neck now is much shorter than in an adult, and thicker in proportion to the size of the thigh.

THE next superior *epiphysis* in size, is called the great *trochanter*, *e.* which is joined, as has been hinted, to the head by the cartilage that forms the superior part of the neck. It is broad at bottom, and ends at top in an obtuse angle. The convex or external side is pretty smooth, not having such impressions in it as usually are in adults; but the large cavity on the external side, in which is received the tendon of the *glutæus minimus*, is as deep, in proportion to the bigness of the part, but not so wide, as it is at maturity.

JUST under the posterior and inferior part of the basis of the neck is situated the third and smallest of these *epiphyses*, called the little *trochanter*, *d.* It is formed by the continuation of the cartilage down from the neck. It rises from the surface of the bone almost in the

the shape of a cone. It is now much rounder, and ends more acute, than in adults.

ON that part of the cartilage, which is between the little *trochanter* and the cartilaginous part of the neck, there are many holes much like those, which are visible in the same place in adults.

THE inferior *epiphysis* of the thigh bone, *b.b.* differs in shape very little from the adult. Its *condyles*, *b. b.* are much the same, but the distance between them is somewhat greater, *i.* At the bottom of the cavity between them there are many little holes, and on the inner side of each *condyle*, there is now the semilunar impression. It has an ossification in its middle, *fig. 8. g.*

THE bone to which these described *epiphyses* are joined, is long, and curved a little backward, but not so much as in adults. From the *trochanters* down almost to the middle of the bone it gradually lessens, and grows round; then it gradually increases in width, and grows near its extremity convex on the anterior side, and flat on the posterior. In the fore part, near to its conjunction with

R

the

130 HUMAN OSTEOGENY.

the inferior *epiphysis*, there is a small cavity for the upper part of the *patella* to play in, which after birth considerably increases. In the place of the great ridge, called *linea aspera ossis femoris*, there is but a very small rising and roughness; but most of the other protuberances, usually observable on adult thigh bones, are not visible.

THE thigh bone begins to ossify in the same manner, as I have mentioned of the *os humeri*, about a month after conception, and then all its *epiphyses*, except the little *trochanter*, are formed in their proper shape.

ABOUT three months, the little *trochanter* appears, which then, together with the head, neck, and great *trochanter*, are all contained in one inseparable cartilage, which reaches a little below the small *trochanter*, *fig. 5.*

AT four months, the bone and all its parts have nearly the same shape it has at nine, tho its neck is entirely cartilaginous, and continues so until about eight months, *fig. 4.*

BETWEEN eight and nine months, the ossification begins in its inferior *epi-*
physis

physis about its middle, *plate vi. fig. 11.* and gradually increases in the manner I shewed you in the first lecture. This is the first *epiphysis* that ossifies in the body.

THE second division of this extremity, called the leg, consists of three bones, the *patella*, *tibia*, and *fibula*.

THE *patella*, which is a small round-^{*Patella.*}ish bone, almost flat on its external side, and convex next the articulation, is at birth altogether cartilaginous, *plate vi. fig. 2. a.* It is joined to the *tibia* by a strong ligament, which penetrates into the substance of its inferior rim, *b.* and into the *tibia* a little below its superior *epiphysis*, *c.* The texture and insertions of which ligament are most visible in *fœtuses*.

THE *patella* is formed as soon as any other part of the leg, and in much the same shape it has at birth.

THE *tibia* is a long bone, with a con-^{*Tibia.*}siderable *epiphysis* at each end. The superior, *fig. 2. d.* which is cartilaginous, except about its center, where there is a small ossification like that in the lower *epiphysis* of the thigh bone, *fig. 8. f.* has

two *condyles*, the external of which is much less at birth than the internal, tho in adults the contrary is generally found. The top of this *epiphysis* is divided by the protuberance, to which the ligaments are attached, into two surfaces nearly horizontal; these in adults are both a little concave, but in full grown *fœtuses* the external one is a little convex. On these surfaces are placed the femilunar cartilages, by which the convexity of the *epiphysis* is enlarged. In these cartilages I don't find any remarkable difference from adults.

THE anterior side of the *epiphysis* is smooth, and full of small holes. That part, which has been called the spine, and supposed to be designed for the insertion of the strong ligament of the *patella*, and also taken for an *epiphysis*, is at birth only a cartilaginous continuation of the great *epiphysis*, which ends just above the insertion of that ligament.

THE inferior *epiphysis* of the shin bone is not near so large as the superior, *fig. 2. e.* On the external side of it is the longitudinal depression, in which is received

ceived the upper part of the inferior *epiphysis* of the *fibula*, which cavity is almost as large as in adults, *f*.

ON the inside of this *epiphysis* is the cartilaginous *apophysis*, *g*. which forms the inner ankle, the end of which is much more sharp than in an adult. The small *fossa*, in which the tendon of the *musculus tibialis anticus* is lodged, may now be seen.

THE bottom of this *epiphysis* ends in a square cavity, the sides of which are not now near so high as in an adult.

THE greatest part of the bone of the *tibia* is triangular. From the insertion of the *ligamentum patellæ*, down near three fourths of its length, *fig. 2. c. h*. there is a sharp ridge, which toward the bottom of the bone gradually lessens, very like what is seen in adults. The back part of the bone is smoother, the lateral edges rounder, and the hollow at the bottom of the external side for the reception of a small part of the inferior extremity of the *fibula*, is much less than at maturity.

THE *fibula* is at birth straighter than in *Fibula.*
an adult, *fig. 2. i*. and at top less round :
the

134 HUMAN OSTEOGENY.

the greatest part of it is flat, and part of its anterior edge much sharper than the posterior, where in adults it is irregularly triangular.

AT its superior extremity there is an *epiphysis*, *k*. the top of which flants off, and forms almost a point, where in adults there is a broad edge.

AT the inferior end there is a larger *epiphysis*, by which is formed the external ankle, *l*. It is narrower and longer, in proportion to the size of the whole bone, than in adults. It now has the sinuosity on its back part for the tendons of the *musculi peronei*.

BOTH the *tibia* and *fibula* begin to ossify in the same manner, and about the same time, as the thigh bone does, and also gradually increase in the same manner, and much in the same proportion.

THE superior *epiphysis* of the *tibia* does not begin to ossify until near nine months, and is the second *epiphysis* that ossifies.

THE last part of the lower extremity of the skeleton is usually divided into three parts, the bones of the *tarsus*,
meta-

metatarsus, and toes, to which must be added the *ossa sesamoidea*.

THE bones of the *tarsus* are seven in number, *fig. 3.* The places of the five smallest of these are always entirely at birth supplied with cartilages of much the same figure of those in adults; 3, 4, 5, 6, 7. but the two largest, 1, 2. which are the *astragalus* and *os calcis*, have a large ossification within each of them, *fig. 14, 15.* which begins in the *os calcis* about four months, *fig. 4. d.* but in the *astragalus* not until five or six after conception.

ALL these bones are generated distinct, and articulated in the same manner as they are at birth, as soon as they are generated.

THE *ossa metatarsi*, which are five in number, have at each end of them *epiphyses* wholly cartilaginous, *fig. 3. a. b.* and the bodies, which are long bones, *c.* have not any very remarkable difference from the adult.

BETWEEN two and three months after conception, these bones begin to ossify in the same manner as the larger cylindrical bones do.

THE

Bones of
the toes.

THE bones of the toes have, at birth, like those of the fingers, cartilaginous *epiphyses* at each of their ends next the *metatarsal* bones, *fig. 3. e.d.* The greatest part of the last bone of all the small toes is cartilaginous. *f.*

THESE bones begin to be generated much about the same time, and much in the same manner, as those of the fingers, except the last *phalanx* of the small toes.

Ossa sesa-
moidea.

THE only parts of a foetal skeleton, which remain to be taken notice of, are the *ossa sesamoidea*, which all the writers, I have met with on this subject, have wholly passed over unobserved. The number of them in *fætuses* are, as in adults, very different in different subjects. Those, which are the most constantly found, are two in the bottom of the foot, fixt in the ligament of the articulation of the first bone of each great toe, with its *os metatarsi*. In all *fætuses*, from three months after conception to birth, the places of these *ossa sesamoidea* are always filled with cartilages of nearly the same shape those *sesamoide* bones usually have, when they are arrived at perfect

perfect maturity, *plate iv. fig. 18. a. a.*, *fig. 19. a. a.* In one subject at birth I found, in each of the *sesamoide* bones of one foot, a very small point of ossification.

IN like manner those *ossa sesamoidea*, which are sometimes found at the beginning of the *musculi gastrocnemii*, are to be seen in *fætuses*.

By the descriptions I have now given of all the different parts of fœtal skeletons, it manifestly appears, that there is not one single bone, except the teeth, or one *epiphysis* in an adult skeleton, which is not to be found in a full grown *fætus*, or in its place a cartilage of nearly the same shape: consequently, the account cannot be right, which the ingenious professor * *Monro* gives of the *ossa sesamoidea* being “ nothing else than the
“ ligaments of the articulations, or the
“ firm tendons of strong muscles, or
“ both, become bony by the violent compression they suffer in the situation
“ they are.”

* *Anat. of the bones, Edin. 1726. p. 337.*

1824

1824

1824

1824

1824

1824

1824

1824

1824

1824

1824

1824

1824

THE
EXPLICATION
OF THE
PLATES.

PLATE I.

Figure 1. **R**EPRESENTS the skull
of a *fœtus* of nine
months in its natural
size.

- a.a.* The two frontal bones.
- b.* The *fontanella*.
- c.* The superciliary ridge.
- d.* The hole for the optic branch
of the fifth pair of nerves.
- e.* The orbital process of that frontal
bone.
- f.* The *os parietale*.
- g.* The anterior and inferior end of that
bone which reaches over the tem-
poral process of the *sphenoide* bone.

140 The EXPLICATION

- b.* The *os squamosum*.
- i.* Its *zygomatic* process.
- k.* Part of the *petrosus*.
- l.* The temporal process of the *sphenoid* bone, in the opening over which are three small *ossa Wormiana*.
- m.* *Os nasi*.
- n.* *Os unguis*.
- o.* *Os malæ*.
- p.* *Os maxillare superius*.
- q.* Its nasal process.
- r.* Its orbital process.
- s.* The hole called *orbiter externus*.

Fig. 2. Represents the bottom of the skull of a large full grown *fœtus*.

- a.a.* The palate processes of the *ossa maxillaria superiora*.
- b.* A suture that runs cross the anterior part of the palate.
- 1, 2, 3, 4, 5.* The cavities in which the teeth in their bags are contained.
- 6.* The hinder part of the *vomer*.
- c.c.* *Ossa palati*.
- d.* The *pterygoide* process of the *sphenoid* bone.
- e.* The hook of its inner *ala*.

f. Part

- f. Part of the body of the *sphenoid* bone.
- g. Part of the *os parietale*.
- h. The fissure, thro which passes that branch of the fifth pair of nerves, called *chorda tympani*.
- i. The *zygomatic* process of the *os squamosum*.
- 7. The same named process of the *os malæ*.
- k. The cartilage at the end of the *os petrosum*.
- l. That part of the *os petrosum* on which afterwards grows the *mastoide* process.
- m. The triangular or first bone of the *occiput*.
- n. n. The cartilages which join the second and third bone of the *occiput* to the first.
- p. p. The second and third bones of the *occiput*.
- q. The fourth bone.
- r. r. The cartilages, which join the three first of the occipital bones and the hinder part of the *os petrosum* together.
- s. s. Two *ossa triquetra*.

v. The

- v. The entrance of the *carotide* artery into the *os petrosum*.
- w. Its exit out of the same bone.
- x. The entrance of the *tuba Eustachiana* into the anterior part of the *cavitas tympani*.
- y. z. The two ends of the bone called *annulare* or *annulus*.

Fig. 3. Represents an *os frontis* of a *fœtus* of four months after conception, a little magnified, the better to shew its texture.

Fig. 4. Is an *os frontis* of a *fœtus* between two and three months.

Fig. 5. An *os parietale* of a *fœtus* of six months, or a little more.

f. The rising in its middle, perfectly smooth, from whence the fibres seem to shoot like *radii*.

Fig. 6. An *os parietale* of a *fœtus* of four months, a little magnified, as *fig. 3.*

Fig. 7. Another of a *fœtus* of two months.

Fig. 8.

Fig. 8. Represents the inside of the first bone of a full grown foetal *occiput*.

m. The slit at its superior angle.

n. n. The notches or slits at the lateral angles.

o. A groove from the bottom of the upper slit to the middle of the bone.

Fig. 9. Represents the inside of the second, third, and fourth bones of the *occiput*.

n. n. The cartilages at the hinder ends of the second and third bones, by which they join the first bone.

p. p. The second and third bones of the *occiput*.

q. The fourth bone.

r. r. The cartilages at the anterior ends of the second and third bones, by which they join the fourth bone.

s. The cartilage, which joins the fourth bone to the body of the *sphenoide* bone.

Fig. 10. The external side of the four bones of the *occiput* of a *fœtus* of four months.

Fig. 11.

144 The EXPLICATION

Fig. 11. The inside of the first bone of the *occiput* of a *fœtus* a little under three months.

- a. The bony incrustation on its inferior part.
- b. Its superior or reticular part.

Fig. 12. Represents an external view of an *os temporis* of a full grown *fœtus*.

- b. The *os squamosum*.
- i. The root of the *zygomatic* process.
- l. The hinder part of the *os petrosum*.
- k. The cartilage, which furrounds the hinder end of the *petrosum*.
- m. The membrane, which covers the *membrana tympani* peculiar to the *fœtus*.
- n. The *membrana tympani*.
- o. o. o. The *annulus*.

Fig. 13. Is a view of the inside of the *os temporis*.

- b. The *os squamosum*.
- i. i. The ridge by which the *squamosum* is joined to the *petrosum*.
- l. A small hole generally to be seen in *fœtuses*, and seldom, if ever, in adults.

m. The

- m.* The ridge, made by the superior semicircular canal.
- n.* The large hole under that ridge.
- o.* The *meatus auditorius internus*.
- p.* The sharp ridge, which runs from the superior semicircular canal to the end of the bone.
- q.* The cavity for the *sinus lateralis duræ matris*.
- r.* A small hole, amidst several less, only to be seen in a *fœtus*.
- s.* The opening of the *canalis Fallopii*.

Fig. 14. The inferior external side of the *os petrosum* of a full grown *fœtus*.

- a.* The *styloide epiphysis*.
- b.* The hole called *aquæductus Fallopii*.
- c.* A small and very sharp process, generally destroyed by cleaning the bone.
- d.* The beginning of the passage of the *carotide* artery.
- e.* The ending of that passage.

PLATE II.

Fig. 1. Represents the temporal bone of a *fœtus* of six months.

a. The beginning of the *tuba Eustachiana*.

b. The hinder part of the *os petrosum* partly cartilaginous.

Fig. 2. The *os temporis* of a *fœtus* of four months.

a. The *os squamosum*.

b. b. The *os petrosum*, almost wholly cartilaginous.

d. The *styloide epiphysis*.

Fig. 3. A view of the inner side of the *os petrosum* of a *fœtus* of four months.

Fig. 4. The same as figure 3. flit.

Fig. 5. The *os squamosum* of a *fœtus* of four months.

Fig. 6. The same bone of a *fœtus* of three months.

Fig. 7. Represents a view of the *cavitas tympani* of a full grown *fœtus*, with the bones of the ear in their natural situation.

a. The

- a. The long and slender process of the *malleus* in its natural situation.
- b. The connexion of the heads of the *malleus* and *incus*.
- c. The *foramen rotundum*.

Fig. 8. Represents the inner side of the *os squamosum* of a full grown *fœtus*, with the *annulus*, *malleus*, and *incus*, and a small part of the *os petrosum*.

- a. The inside of the *membrana tympani*.
- i.i. The ridge by which the *os squamosum* is joined to the *petrosum*.
- l. A small hole peculiar to *fœtuses*.
- m. The part of the *os squamosum*, which makes the upper and external side of the *tympanum*, in which are small *cancelli*.

Fig. 9. Represents the *os petrosum* of a *fœtus* of seven months, in which appears the *cavitas tympani*, without the small bones.

- a. The *foramen ovale*.
- b. The *foramen rotundum*.
- k. The cartilage at the end of the *petrosum*.

148 *The* E X P L I C A T I O N

Fig. 10. Represents the *cochlea a* and the three semicircular canals, *b. c. d.*

Fig. 11. The *os petrosum* of a *fœtus* of seven months, slit.

Fig. 12. The *os annulare*, or *annulus*, of a full grown *fœtus*.

Fig. 13. The same bone of a *fœtus* of seven months.

Fig. 14. The same of three months.

Fig. 15. The *malleus*.

a. Its long process.

b. Its handle.

c. Its little process.

a. Its head.

Fig. 16. The *malleus* slit.

Fig. 17. The *incus*.

a. Its short leg.

b. Its long leg.

c. The *os orbiculare*.

d. The head of the *incus*.

Fig. 18. The *incus* slit.

Fig. 19.

Fig. 19. The *stapes*.

a.a. Its legs.

b. Its basis.

c. Its head.

Fig. 20. A view of the internal side of the *sphenoide* bone of a full grown *fœtus*.

b.b. Its great wings.

c. The cartilage by which it joins the fourth bone of the *occiput*.

d.d. The posterior *clinoide* processes, entirely cartilaginous.

e. The *sella Turcica*.

f.f. The anterior *clinoide* processes, wholly bone.

g.g. The little wings.

h. The notch in which part of the *crista galli* is received.

i.i. The lateral processes of the body of the *sphenoide* bone, to which the great wings are fixt.

Fig. 21. A view of the external side of *fig. 20.*

a. The body of the *sphenoide* bone.

b.b. Its great wings.

c. The cartilage at the end of the body.

d. Its

150 *The* EXPLICATION

- d.* Its *azygos* process.
- e.* The temporal process of the great wing.
- f.* The orbital process.
- g.g.* The little wings.

Fig. 22. Is a great wing of the *sphenoide* bone of a *fœtus* of six months.

Fig. 23. The inner side of the body of the *sphenoide* bone of the same *fœtus* as *fig. 22.*

- c.* The cartilage next the *occiput*.
- d.d.* The posterior *clinoide* processes, cartilaginous.
- e.* The *sella Turcica*, mostly bone.
- f.f.* The anterior *clinoide* processes, cartilaginous.
- g.g.* The little wings, wholly ossified, except at *h*.
- i. i.* The lateral processes.

Fig. 25. Represents the body with the little wings of the *sphenoide* bone, together with the second, third, and fourth parts of the *occiput* of a *fœtus* of three months, but little ossified.

a.b.c. Small points of ossification in the body and little wings of the *sphenoide*,

Fig. 26.

Fig. 26. Is part of the *os ethmoides* cartilaginous, and the *vomer* bony.

a. The *septum nasi*.

b. The *crista galli*.

c. One side of the *vomer*.

d. The bottom of the *vomer*, by which it joins the *ossa maxillaria superiora*, and the *ossa palati*.

Fig. 27. Represents the same parts as the last of a *fœtus* of a little more than four months.

Fig. 28. Represents one of the external sides of the *nares*.

a.b.b. The *ossa spongiosa superiora*.

c. The inside of the *os nasi*.

d. The *os spongiosum inferius*.

e. Part of the *os maxillare superius*.

Fig. 29. Represents the *os planum b.* with a cartilage, *a.a.a.* surrounding the greatest part of it.

30, 31. The *ossa spongiosa* of a *fœtus* of six months.

PLATE III.

Fig. 1. Represents the inside of the *os unguis* of a full grown *fœtus*.

Fig. 2. The external side of the *os malæ* of the same age.

Fig. 3. The internal side of the *os malæ* of a *fœtus* of four months.

Fig. 4. Represents the external side of an *os maxillare superius* and *os palati* of a full grown *fœtus*.

- a.* The nasal process of the *os maxillare*.
- b.* Its orbital process.
- c.* The cavity in which part of the *os malæ* is fixt.
- d.* The orbital process of the palate bone.

Fig. 5. The side next the *nares* of the *os maxillare superius* and *os palati*.

- a.* The inside of the nasal process of the upper jaw bone.
- b.* The passage of the lachrimal duct into the *nares*.
- c.* The process by which this bone is connected to its fellow on the other side,

e. e. e. Part

- e. e. e.* Parts of the side and bottom of the *nares*, formed by this jaw-bone.
- d.* The *antrum Highmorianum*.
- f.* The orbital process of the palate bone.
- g.* That part of the *os palati*, which makes the hinder part of the side of the *nares*.
- h.* The end of the *lamella* of the maxillary bone, under which slides part of the *os palati*.

Fig. 6. Represents the *os palati* of a full grown *fœtus*.

- a.* The process, which joins the process of the *sphenoide* bone.
- b.* The process, which runs under the thin *lamella*, on the palate part of the upper jaw-bone.
- c.* The nasal process.
- d.* The orbital process.

Fig. 7. The *os maxillare superius* of a *fœtus* of four months.

Fig. 8. The *os palati* of a *fœtus* of the same age.

Fig. 9. The under jaw of a full grown *fœtus*.

U

a. a. Its

154 *The* EXPLICATION

- a. a.* Its two parts.
- b.* Their connexions together by ligaments.
- c. c.* The *condyloide* processes.
- d. d.* The *coronoide* processes.
- 1, 2, 3, 4, 5. The cavities for the teeth.

Fig. 10. A view of the inside of an under jaw-bone of a *fœtus* of six months.

Fig. 11. The same of a *fœtus* of three months.

- a.* The bottom of the cavities of the *molars*.
- d.* The *coronide* process.

Fig. 12. The same bone of *fœtus* of four months.

- a.* The inner side of the bone in part only generated.

Fig. 13. The gums and teeth-bags of a full grown *fœtus*, as they appear when pulled out of the jaw.

- a. a. a.* The gums.
- b. b. b. b. b. b.* The bags containing the teeth.

Fig. 14,

Fig. 14, 15, 16, 17. The bony shells of the teeth, which are contained in the bags at birth.

Fig. 18. The gums and teeth-bags of a *fœtus* of five months.

Fig. 19. What is formed of the teeth at five months.

Fig. 20. The *os hyoides* of a full grown *fœtus*.

a. a. Its horns.

b. Its body.

c. c. The connexions or articulations of its horns to its body.

Fig. 21. The same slit.

a. a. The long ossifications in the horns.

b. The ossification in the body.

Fig. 22. An *os hyoides* of a *fœtus* of eight months.

a. An ossification in its body.

Fig. 23. An *os hyoides* of a *fœtus* of four months.

Fig. 24. The *sternum* and cartilaginous parts of the true ribs of a full grown *fœtus*.

U 2

a. The

156 The EXPLICATION

- a.* The articulation of the superior part of the *sternum*.
- b.b.b.b.* The articulations of the cartilaginous ends of the ribs, 2, 3, 4, 5,
- c.* The connexions of the same ends of the two inferior true ribs, 6, 7. on the *sternum*.
- d.* The *processus ensiformis*.

Fig. 25. Another *sternum* of a *fœtus* of the same age as the last, together with the cartilaginous ends, and a small part of the bones of the ribs slit, and part of the *clavicle* slit.

- a.a.a.a.* The ends of the bony parts of the true ribs.
- b.* Part of the *clavicle*.
- c.* Its articulation with the top of the *sternum*.
- d.* The *processus ensiformis*.
- 1, 2, 3, 4, 5, 6, 7, 8. Ossifications in the *sternum* of different magnitudes.

Fig. 26. The *sternum* of a *fœtus* of six or seven months.

- 1, 2, 3, 4, Ossifications of different magnitudes.
- d.* The *processus ensiformis*.

Fig. 27.

Fig. 27. A *sternum* of a *fœtus* of four months.

Fig. 28. fig. 29. fig. 30. The bony parts of three true ribs of a full grown *fœtus*.

Fig. 31. fig. 32. fig. 33. The false ribs of the same age.

a. a. a. Their cartilaginous ends.

Fig. 34. fig. 35. The bony parts of two true ribs of a *fœtus* of three months.

Fig. 36. fig. 37. Two false ribs of the same age.

P L A T E IV.

Figure 1. Represents the anterior view of a full grown foetal spine with thirty-four parts, which are numbered.

Fig. 2. The first *vertebra*, call'd *Atlas*.

a. a. Its lateral bones.

b. b. The cavities which receive the *condyloide* processes of the *occiput*.

c, c. The transverse processes.

d, The

- d.* The arched cartilage, by which the hinder ends of the lateral bones are connected together.

Fig. 3. The second *vertebra*, call'd *dentata*.

- a. a.* Its lateral bones.
b. Its tooth-like process, from whence it has its name.
c. Its body.
d. The cartilage in the place of the spinal process, which is not forked like most of the other *vertebræ* of the neck.

Fig. 4. The last *vertebra* of the neck.

- a. a.* Its lateral bones.
b. Its body.
c. c. The bony parts of its transverse processes.
d. The cartilage, in the place of the spinal process, which is not forked.
e. e. The hinder and cartilaginous parts of its transverse processes.

Fig. 5. A *vertebra* of the back.

- a. a.* Its lateral bones,
b. Its body.

c. c. Its

c. c. Its transverse processes.

d. The cartilage in the place of the spinal process.

Fig. 6. A *vertebra* of the loins.

a. a. Its lateral bones.

b. Its body.

c. c. Its transverse processes.

d. The cartilage, in the place of the spinal process, which is continued round the end of the lateral bones

f. f.

e. The oblique processes.

Fig. 7. A view of the back of a spine of a *fœtus* of seven months, which has exactly the same shape as a full grown *fœtal* one, and is, in proportion to its size, as much ossified.

The superior seven numbers are the *vertebræ colli*.

The next twelve are the *vertebræ dorſi*.

The five numbers lower are the *vertebræ lumbales*.

The next five are the parts of the *os ſacrum*.

The inferior four are the parts of the *os coccygis*.

Fig. 8.

160 *The* EXPLICATION

Fig. 8. A large full grown foetal spine slit.

Fig. 9. The first *vertebra* of the neck slit.

Fig. 10. Part of a full grown foetal spine slit, to shew the bone *a.* flipt out of the cartilaginous cavity *b.* in which it was generated and contained.

Fig. 11. The whole bony part of the body of a *vertebra* of the back.

*Fig. 11.** Part of a like bone to the former slit.

Fig. 12. The spine of a *fœtus* of three months slit, in which a gradation of ossification may be seen.

PLATE V.

Fig. 1. Represents the *os innominatum* of a full grown *fœtus*.

a. *Os ilium.*

b. *Os pubis.*

c. *Os ischium.*

d. d. The

- d.d.* The cartilaginous rim of the *ilium*.
- e.* The cartilage which joins the *Ilium* to the top of the *acetabulum*.
- f.* The cartilage which joins the *os pubis* and *ischium* together, and forms the inferior side of the *foramen magnum*.
- g.* The *acetabulum*.

Fig. 2. An *os innominatum* slit.

Fig. 3. The *os innominatum* of a *fœtus* of three months.

Fig. 4. Another of a *fœtus* of four months.

a. A small ossification in the *ischium*.

Fig. 5. The *clavicle* of a full grown *fœtus*.

Fig. 6. Another of a *fœtus* of four months.

Fig. 7. Another of three months.

Fig. 8. A *scapula* of a full grown *fœtus*.

a.a.a. The basis of the *scapula*, surrounded by the cartilage *b.c.d.*

b. The inferior or large angle of the *scapula*. X *c.* The

- c. The angle at the end of the spine of the *scapula*.
- d. The superior or small angle.
- e. e. The spine.
- f. The inferior *costa*.
- g. The superior *costa*.
- h. The process called *acromion*.
- i. The *coracoide* process.
- k. k. The head of the *scapula*.
- l. The *glenoide* cavity in the head.

Fig. 9. The *scapula* of a *fœtus* of three months.

Fig. 10. The *scapula* of a *fœtus* of four months.

Fig. 11. The *os humeri* of a full grown *fœtus*.

- a. b. The body of the *humerus*.
- c. The cavity at the inferior end of the *humerus*, in which is received the process of the *ulna*, call'd *olecranon*.
- e. The inferior *epiphysis* of the *os humeri*.
- d. The superior *epiphysis*, call'd the head of the *humerus*.

Fig. 12. The *ulna* of a full grown *fœtus*.

a. b. The

- a. b.* The body of the *ulna*.
- c.* Its inferior *epiphysis*.
- d.* The *styloide* process of the inferior *epiphysis*.
- e.* The superior *epiphysis*.
- f.* The semicircular cavity of this *epiphysis*, which is adapted to the *trochlea ossis humeri*.
- g.* The *olecranon*.
- h.* The *conoide* process.

Fig. 13. The *radius* of a full grown *fœtus*.

- a.* The superior *epiphysis*.
- b.* The neck of the *radius*.
- c.* The process at the bottom of the neck.
- d.* The part at which the bone begins to widen, and so continues gradually to do, until it ends in the inferior *epiphysis e*.
- f.* The cavity at the bottom of the inferior *epiphysis*.

Fig. 14. The *os humeri* of a full grown *fœtus* slit, to shew the difference of substance at its extremities *a. a.* from that at its middle *b*.

X 2

Fig. 15.

164 *The* E X P L I C A T I O N

Fig. 15. The *ulna* of a *fœtus* between five and six months, slit.

Fig. 16. The *radius* of the same *fœtus* slit.

Fig. 17. The *os humeri* of a *fœtus* of three months.

Fig. 18. The *radius* and *ulna* of the same *fœtus*.

Fig. 19. The *os humeri* of a *fœtus* of four months.

Fig. 20. Represents the bones of the fore-arm and hand of the same *fœtus* in their natural situation.

- a.* The *ulna*.
- b.* The *radius*.
- c.* The *ossa carpi*.
- d.* A metacarpal bone.
- e.* The first bone of a finger.
- f.* The second bone.
- g.* The third bone.

Fig. 21. Represents the bones of the hand of a full grown *fœtus* in their natural situation.

1, 2, 3, 4, 5, 6, 7, 8. The *ossa carpi*.

- a. The inferior *epiphysis* of a metacarpal bone.
- b. The body of the same bone.
- c. Its superior *epiphysis*.
- d. The first bone of a finger.
- e. The second.
- f. The third.

Fig. 22. The bones of a full grown fœtal finger, and its metacarpal bone flit.

Fig. 23. The *os humeri* of a fœtus under two months.

P L A T E VI.

Fig. 1. Represents the posterior side of an *os femoris* of a full grown fœtus.

- a.a. The body of the thigh-bone.
- b.b. The inferior *epiphysis*.
- c. The head of the thigh-bone.
- d. The little *trochanter*.
- e. The great *trochanter*.
- f. The cartilage that joins the bottom of the inside of the great *trochanter* to the neck of the thigh-bone.
- g. The

166 *The* EXPLICATION

- g. The bony part of the neck of this bone.
- h.h.* The two *condyles* of the inferior *epiphysis*.
- i.* The cavity between the *condyles*.

Fig. 2. Represents the *patella*, *tibia*, and *fibula*, in their natural situations.

- a.* The body of the *patella*.
- b.* The insertion of the *ligamentum patellæ* into the *patella*.
- c.* The insertion of the same ligament into the *tibia*.
- d.* The superior *epiphysis* of the *tibia*.
- e.* The inferior *epiphysis*.
- f.* The connexion of the external side of the inferior *epiphysis* with the *fibula*.
- g.* The process which forms the inner ankle.
- h.* The bottom of the sharp ridge on the fore-part of the *tibia*.
- i.* The body of the *fibula*.
- k.* Its superior *epiphysis*.
- l.* Its inferior *epiphysis*, which forms the external ankle.

Fig. 3.

Fig. 3. Represents the bones of the foot of a full grown *fœtus* in their natural situation.

1, 2, 3, 4, 5, 6, 7. The *ossa tarfi*.

a. b. The two *epiphysis* of a metatarsal bone.

c. The body of the same metatarsal bone.

d. e. The *epiphysis* of the two first bones of that toe.

f. The last part of that toe, but very little ossified.

g. h. The two bones of the great toe.

Fig. 4. Represents the bones of the lower extremity of a *fœtus* of four months.

a. The *periosteum* raised from the bone.

b. The *perichondrium* raised from the cartilage, which appears to be a continuation of the *periosteum*.

c. A small bit of the *perichondrium* turned down, to shew its continuation over every part of the cartilage.

e. The *patella* hanging by its ligament.

d. A small ossification in the *os calcis*.

Fig. 5.

Fig. 5. The *os femoris* of a *fœtus* of three months.

Fig. 6. The *tibia* and *fibula* of the same *fœtus*.

Fig. 7. The *os femoris* of a *fœtus* under two months.

Fig. 8. Represents the *os femoris*, *tibia*, and *fibula* of a full grown *fœtus* slit.

a. a. b. b. Shew the difference between the substance of the extremities of these bones and their middles.

c. c. c. c. The vessels entring the ossification *f.*

d. A small ossification.

e. Several small vessels entring a small red speck, in which I thought I felt bony particles.

g. A large ossification.

Fig. 9. Represents a section of an *epiphysis ossis femoris* just before the bony particles become visible in it.

Fig. 10.

Fig. 10. A section of an *epiphysis tibiæ* just after the ossification becomes visible at *a*.

Fig. 11. Another section of an *epiphysis*, in which the ossification is increased, and various vessels appear, ending in small red specks, *a. a.*

Fig. 12. Another section of an *epiphysis*, in which the ossification is much increased.

Fig. 13. Another section, in which a very considerable inflammation appears round the ossification.

Fig. 14. The *os calcis* of a full grown *fœtus* slit.

Fig. 15. The *astragalus* of a full grown *fœtus* slit.

Fig. 16. The *astragalus* of a *fœtus* of seven months slit.

Fig. 17. The cartilage of an *astragalus*, which had been macerated in water, slit, in order to shew the man-

Y

ner

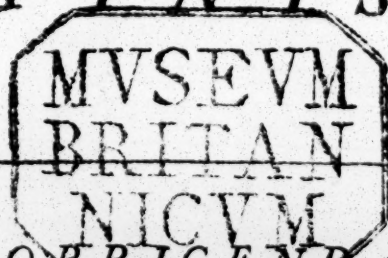
170 The EXPLICATION, &c.

ner in which the bone *a*. slips out of the cartilaginous cavity *b*.

Fig. 18. The bones of the great toe of a full grown *fœtus* slit, with part of the ligament of the joint at the bottom of the first bone, in which are contained two *ossa sesamoidea*, *a. a.*

Fig. 19. The same bones as *fig. 18.* of a *fœtus* of six months, with the *ossa sesamoidea*, *a. a.*

F I N I S.



C O R R I G E N D A.

PAGE 9. line 26. for its read their. p. 12. l. 2. r. membranes which cover it. p. 54. l. 24. for i. i. r. r. r. p. 59. l. 10. dele f. p. 64. l. 13. dele fig. p. 67. l. 9. for of the bone r. of it. p. 92. l. 12. for i. r. h. p. 100. l. 26. r. apparet. p. 103. l. 11. dele at birth. l. 26. dele b. p. 104. l. 6. for e. e. r. b. b. p. 105. l. 12. dele foetal. p. 116. l. 9. for e. r. c. p. 123. l. 14. for coronide r. conoide. p. 139. l. 8. r. the hole for a twig of. p. 148. l. 14. for a. r. d. p. 156. l. 23. r. between six and seven. p. 167. l. 5. r. epiphytes.

ut

of
rt
he
ch
ea,

of
he

mem-
59.
bone
aret.
e. e.
123.
for a
n fix

Fig. 1.

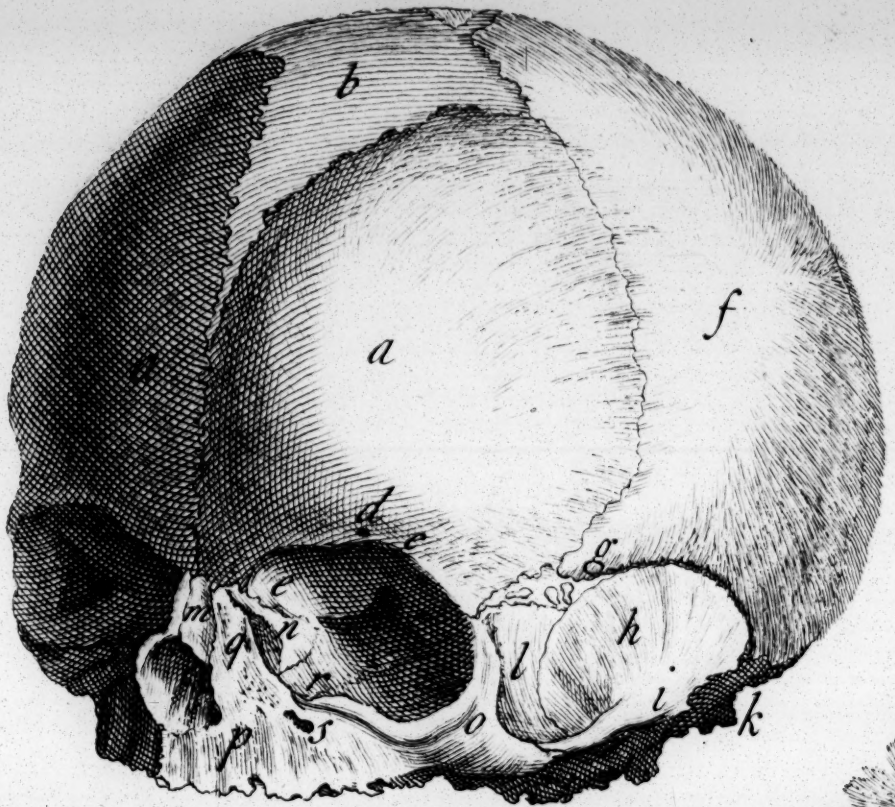


Fig. 5.

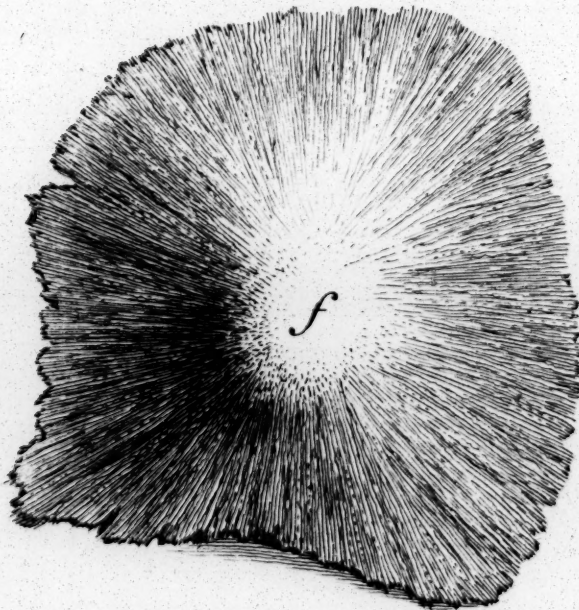


Fig. 14.



Fig. 7.

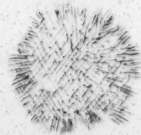


Fig. 12.

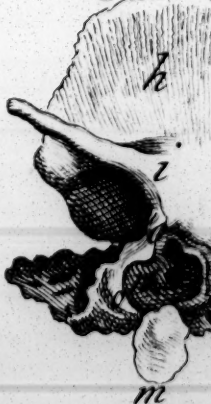


Fig. 6.

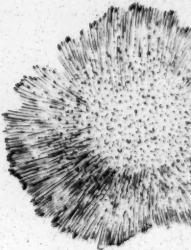


Fig. 13.



Fig. 3.



Fig. 2.

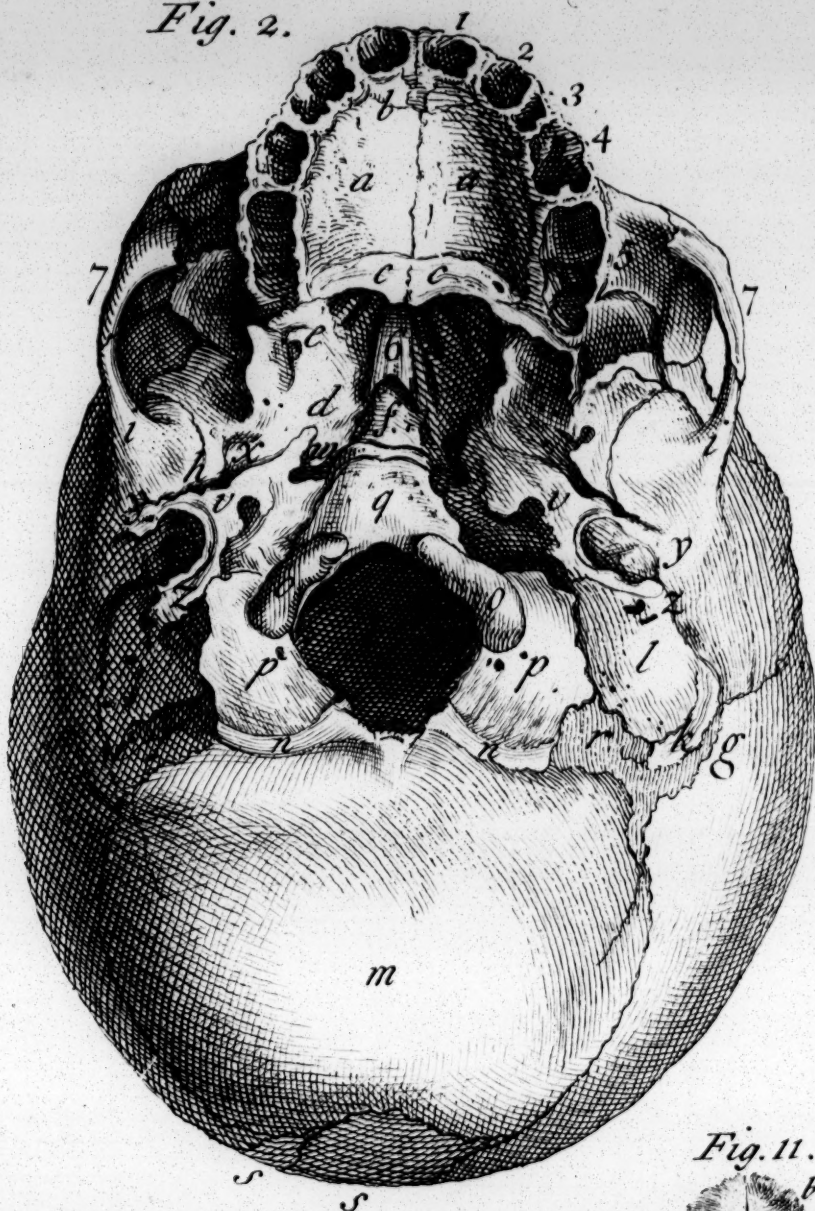


Fig. 4.



Fig. 6.

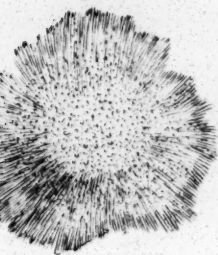


Fig. 13.



Fig. 10.



Fig. 12.



Fig. 11.



Fig. 8.

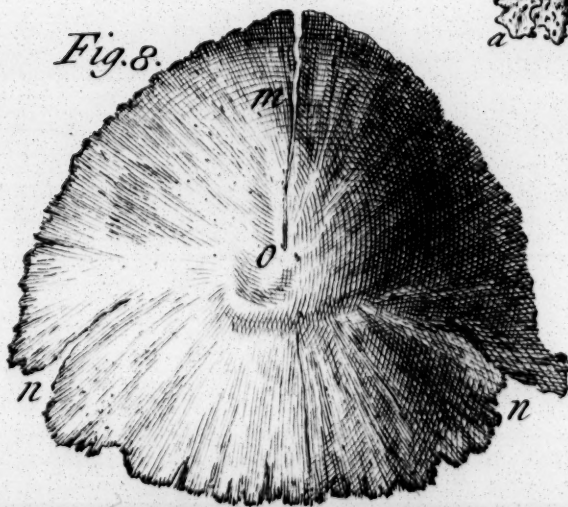


Fig. 9.



J. Myrde deli. et sc.

Fig. 1.



Fig. 2.



Fig. 7.



Fig. 6.



Fig. 5.



Fig. 4.



Fig. 3.



Fig. 12.



Fig. 13.



Fig. 14.



Fig. 19.



Fig. 17.



Fig. 16.



Fig. 15.



Fig. 18.



Fig. 20.

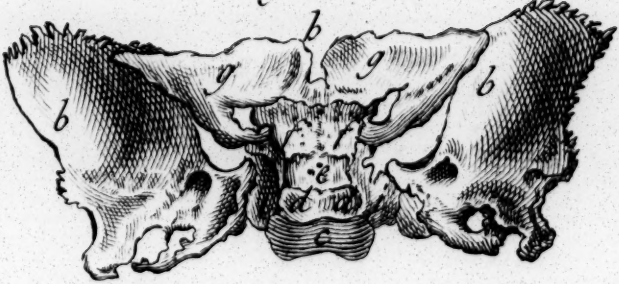


Fig. 24.



Fig. 21.

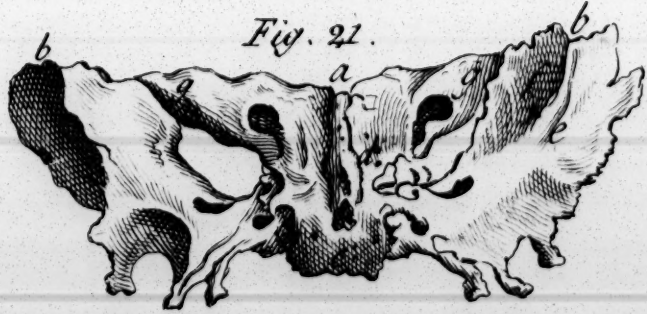


Fig.



Fig. 7.



Fig. 8.



Fig. 10.



Fig. 9.

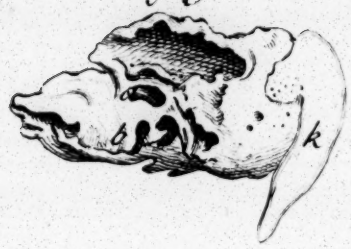


Fig. 11.

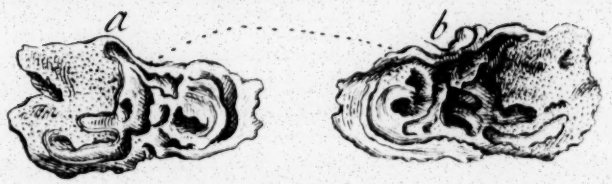


Fig. 15.



Fig. 25.

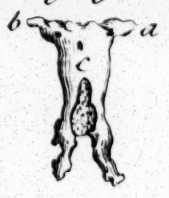


Fig. 27.



Fig. 26.

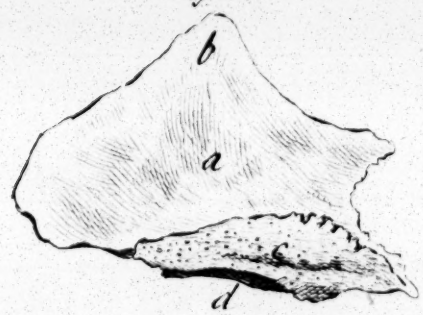


Fig. 24.



Fig. 29.



Fig. 28.



Fig. 22.



Fig. 23.



Fig. 30.

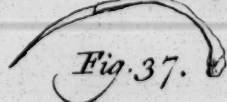
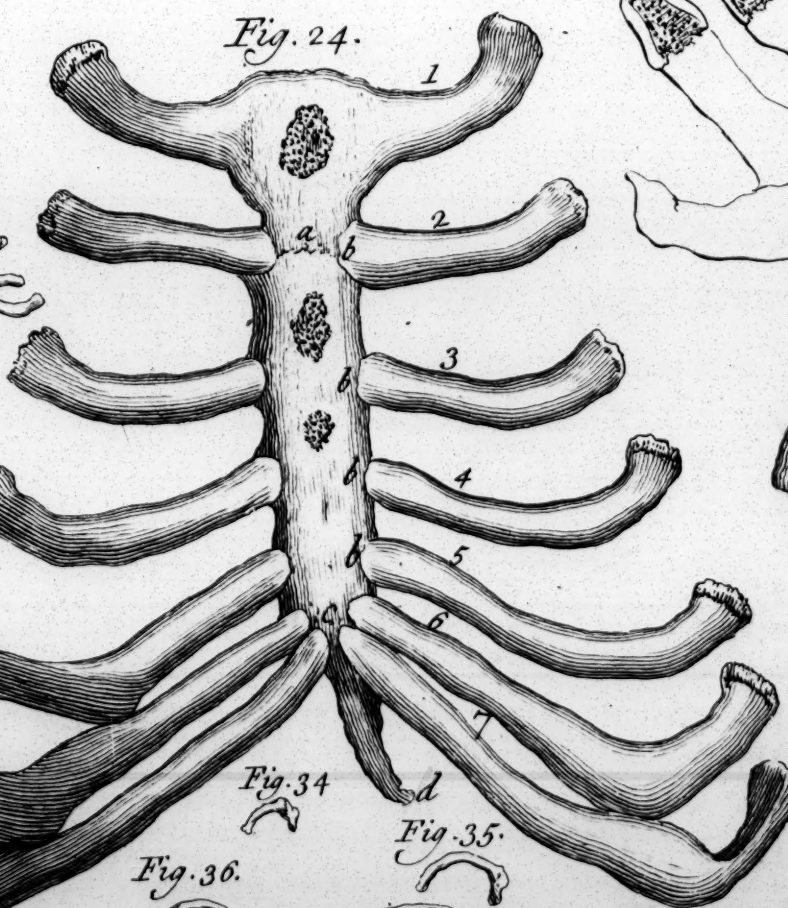
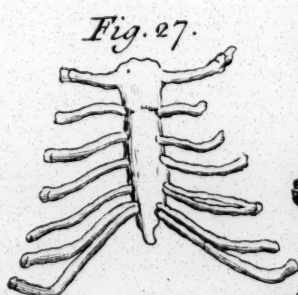
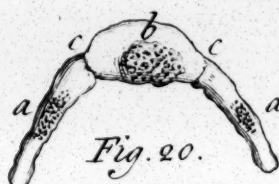
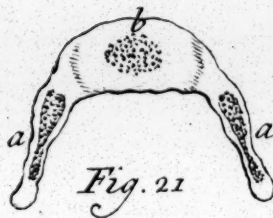
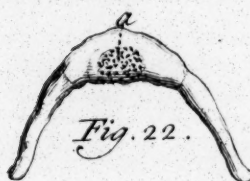
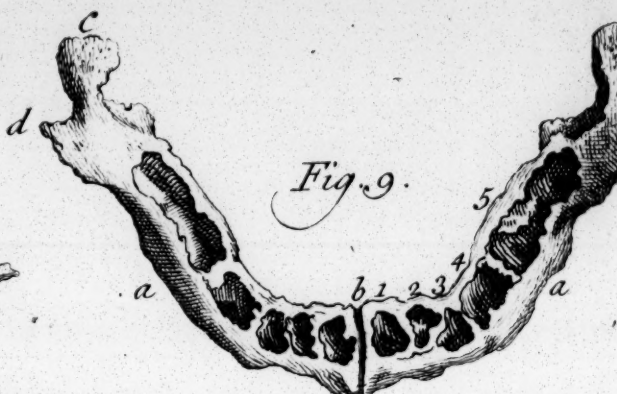


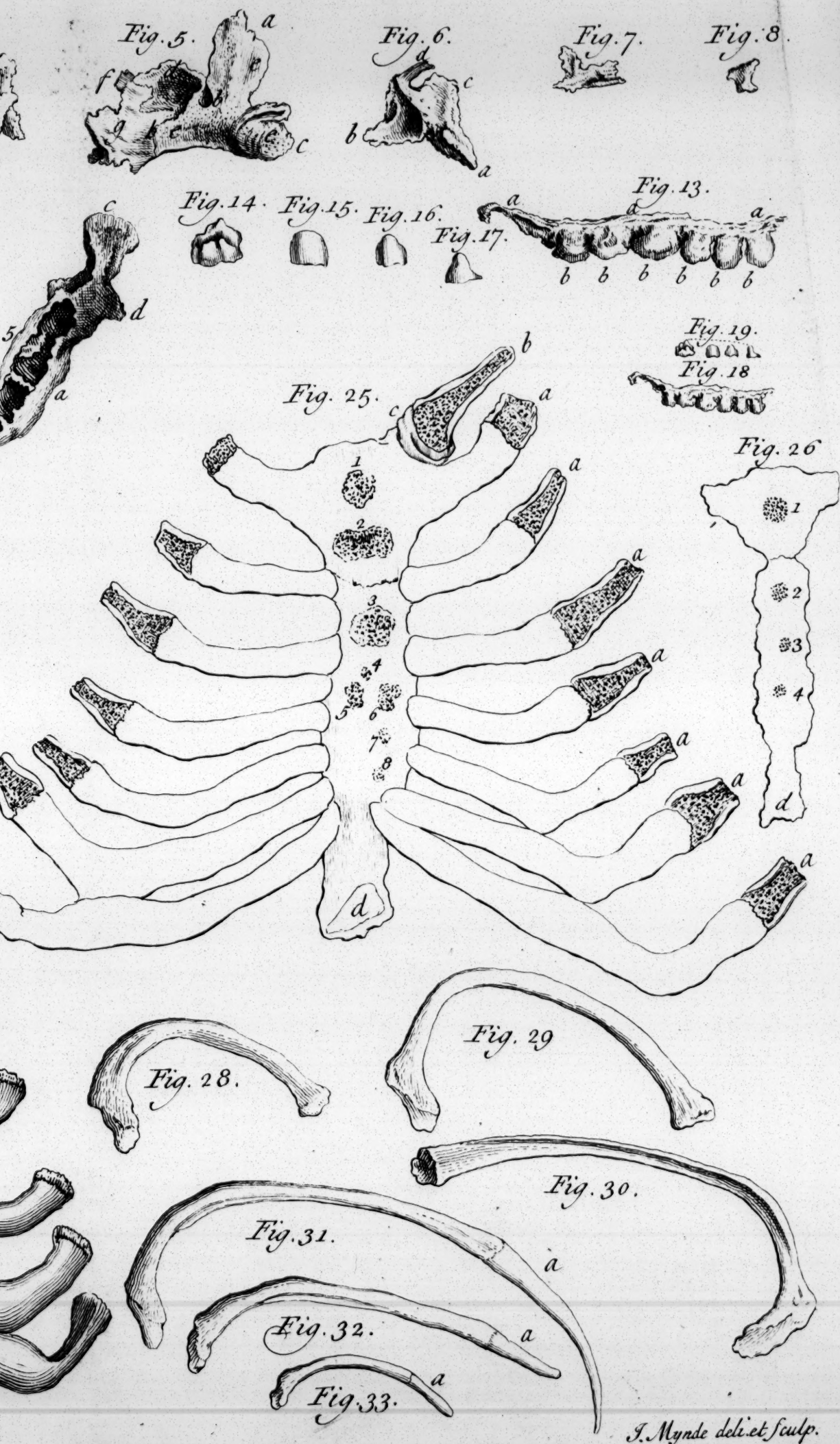
Fig. 31.



J. Myrde deli. et sculp.

P1.III.





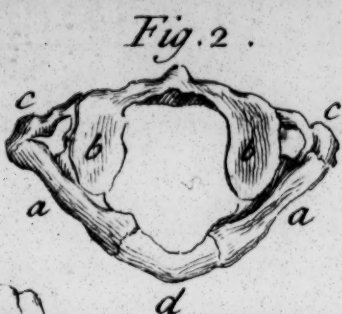


Fig. 8.

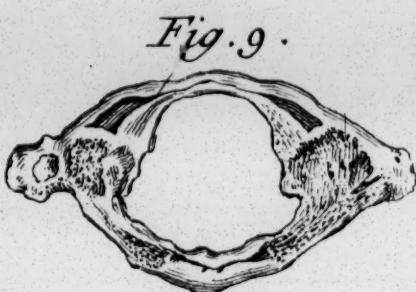


Fig. 1.

* *Fig. 11.*



Fig. 11.



Fig. 5.

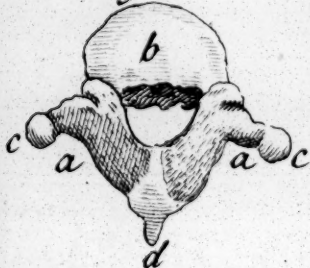
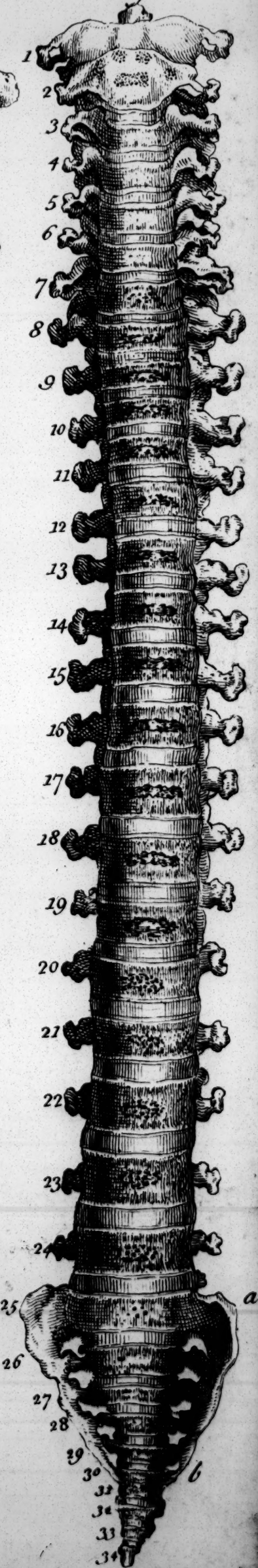
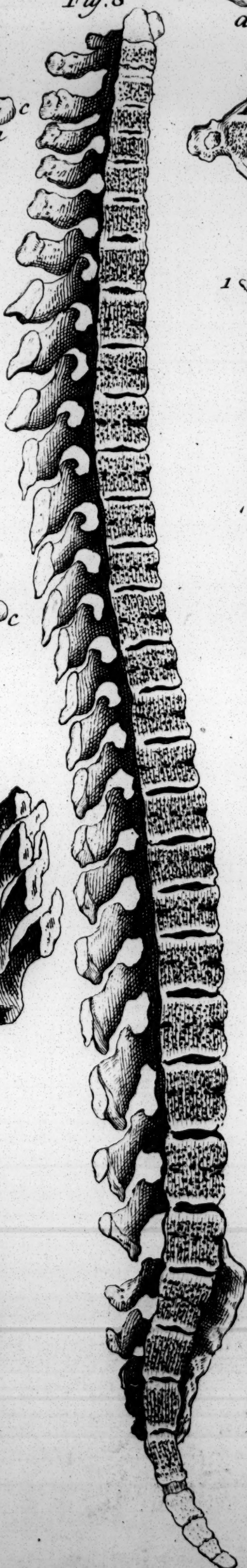


Fig. 10.



Fig. 12.



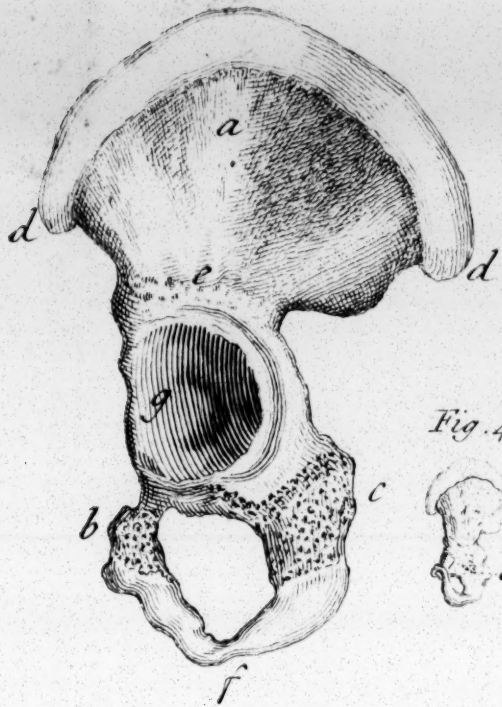


Fig. 4.



Fig. 3.

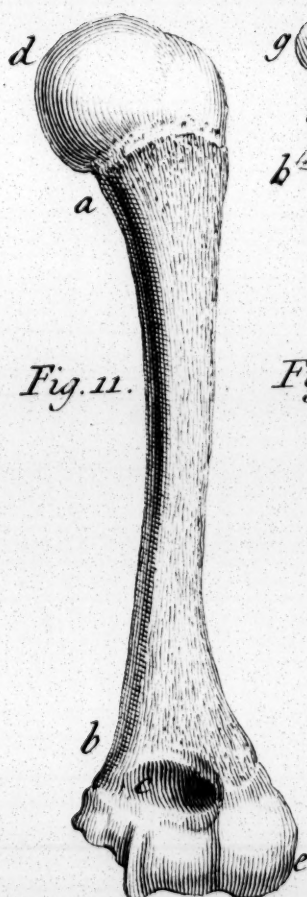
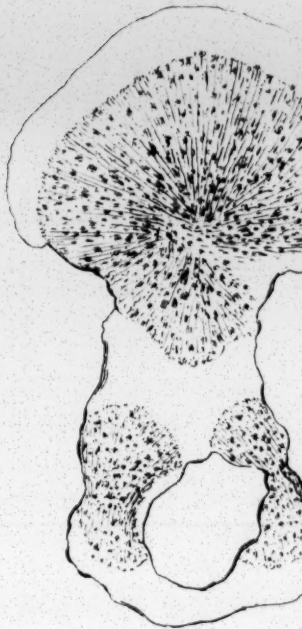


Fig. 11.

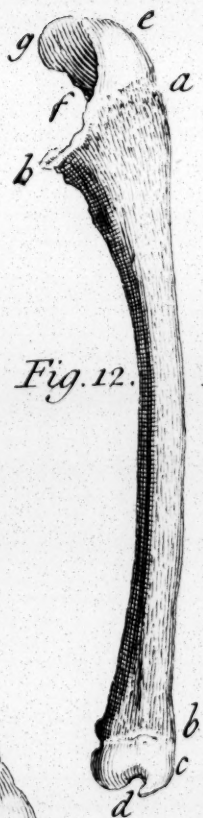


Fig. 12.

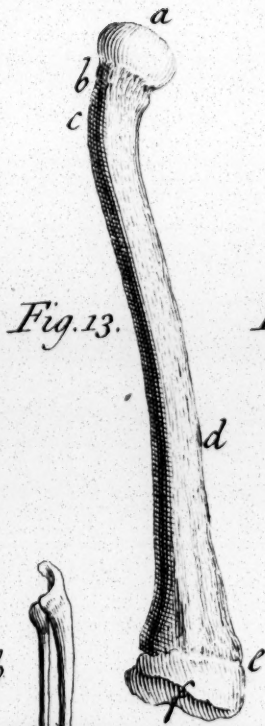


Fig. 13.



Fig. 14.

Fig.



Fig. 20.

Fig.

Fig. 2.



Fig. 5.



Fig. 7.

Fig. 6.

Fig. 8.

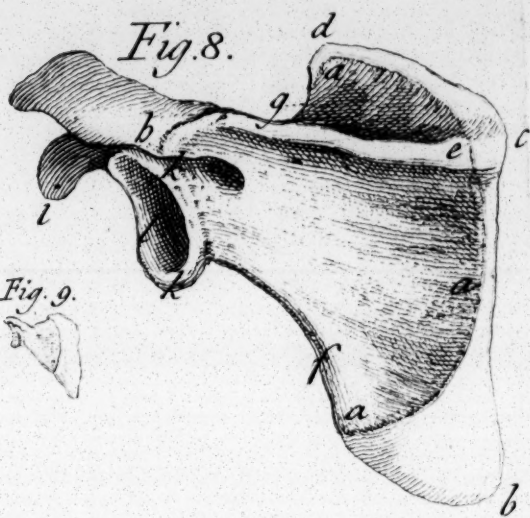


Fig. 10.

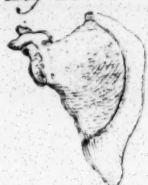


Fig. 21.

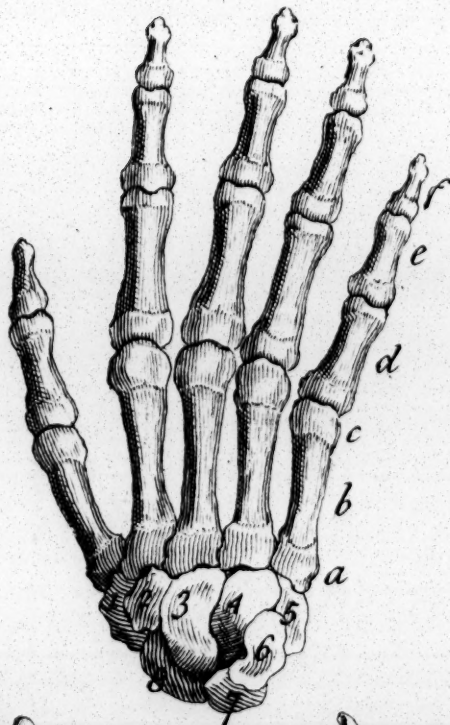


Fig. 22.



Fig. 16.

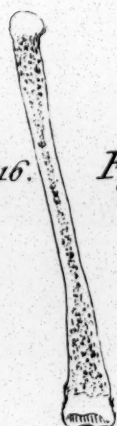


Fig. 15.



Fig. 19.



Fig. 23.



Fig. 17.



Fig. 18.



Fig. 2.

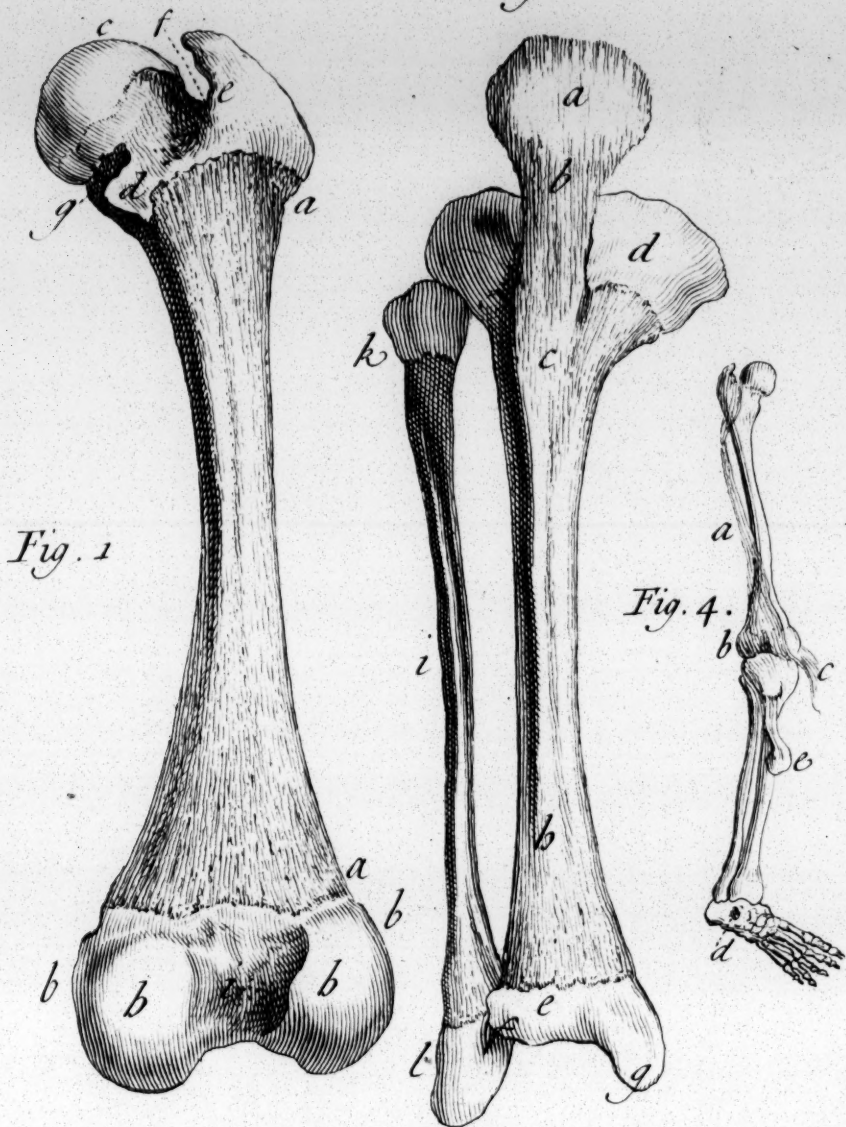


Fig. 3.

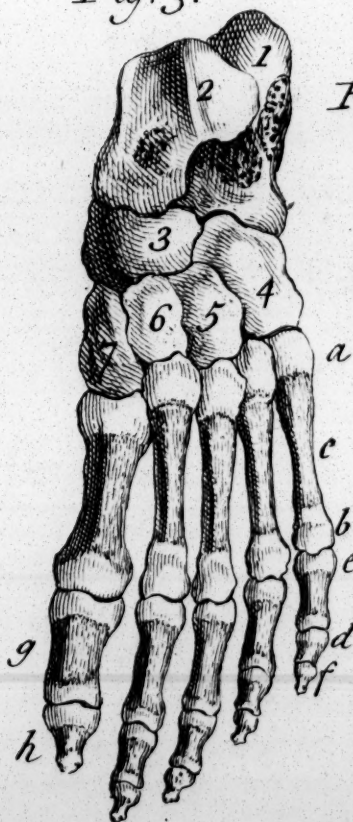


Fig. 7.

Fig. 5.

Fig. 6.

